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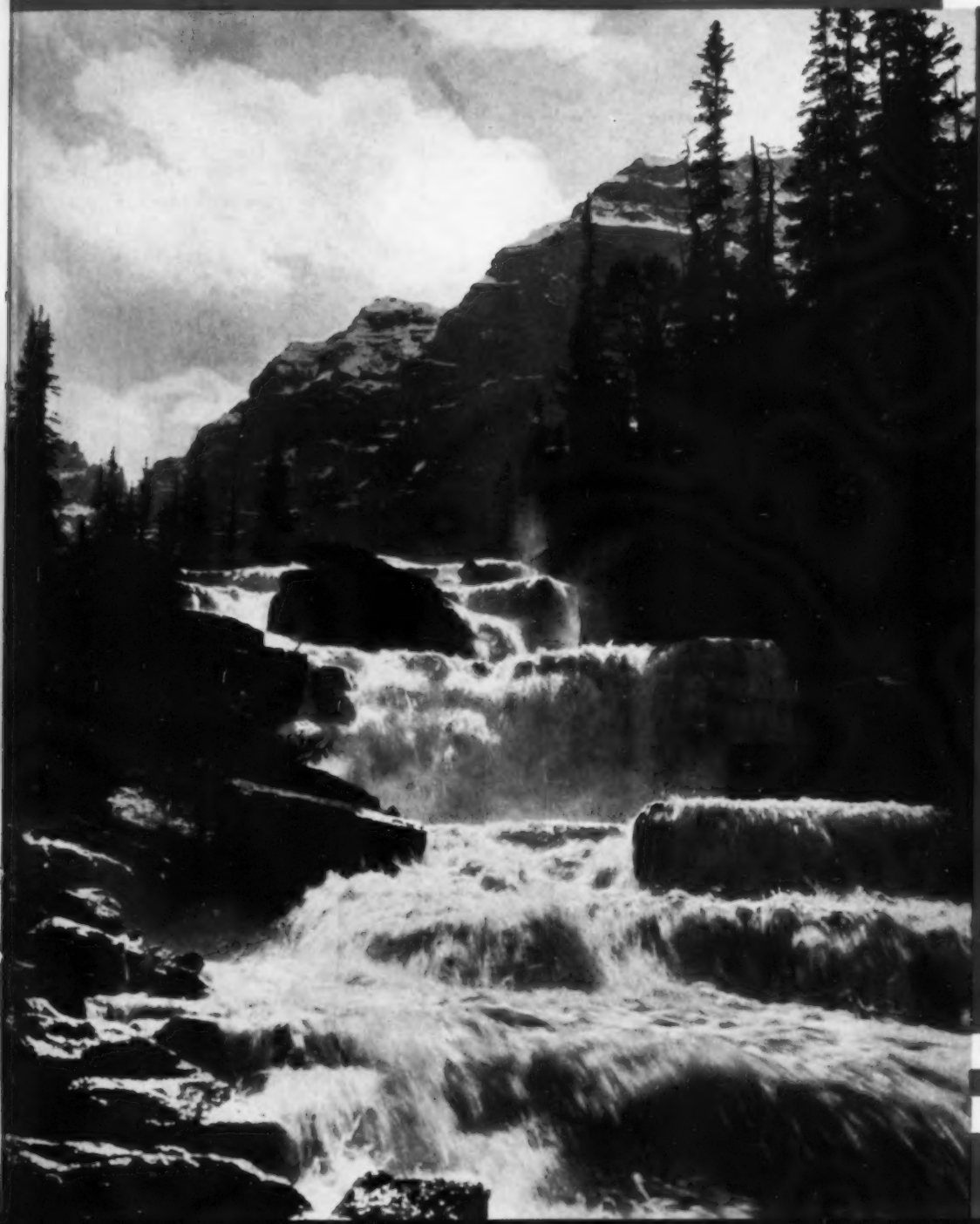

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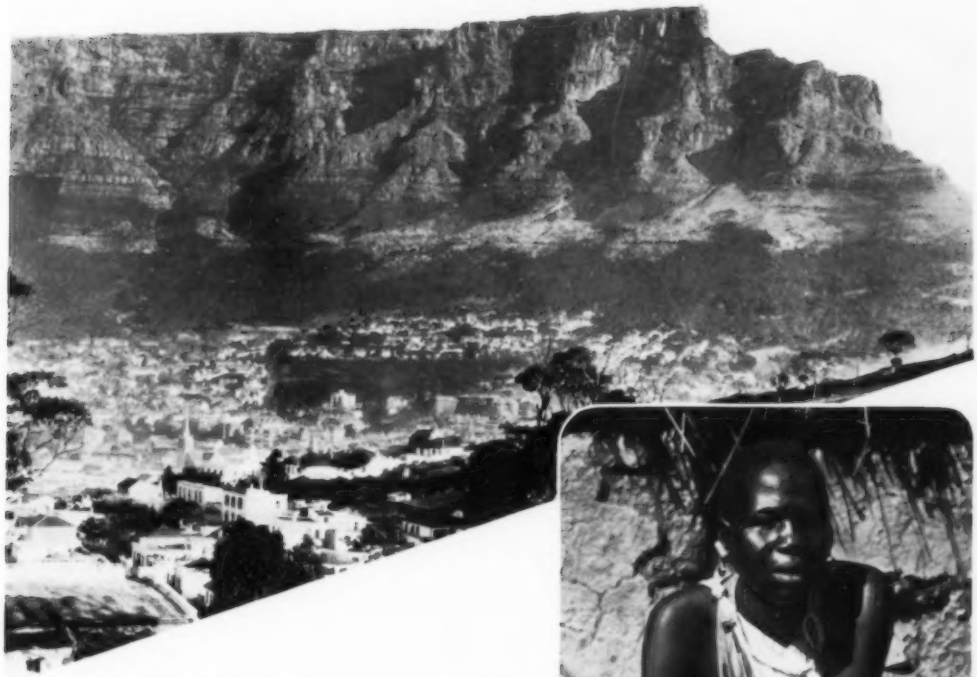

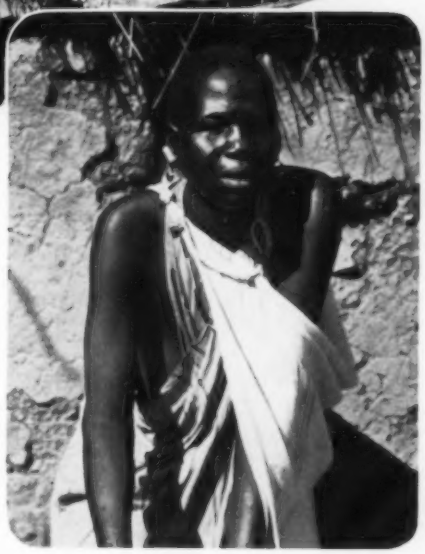

Capetown and Table Mountain
Native Woman Grinding Corn

SOUTH AFRICA is a vast and fascinating land, yet within the scope of a reasonably short visit, one may thrill to the mighty Victoria Falls, tour amidst the wild life of the Kruger National Park, or stand amazed before the eerie beauty of the Cango Limestone Caves. Your days will be bright with sunshine, yet the first star heralds a night of cool and restful slumber. Here, too, the pleasures and amenities of a civilization rejoicing to-day in unparalleled prosperity are heaped upon the visitor. Surf riding, the theatre, sports, music vie with one another to win the traveller's heart.

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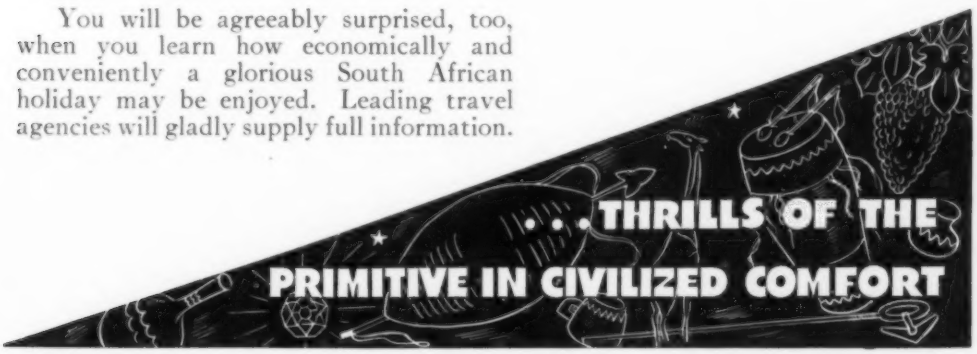

CANADIAN GEOGRAPHICAL JOURNAL

Editor - Gordon M. Dallyn

172 WELLINGTON STREET, OTTAWA

This magazine is dedicated to the interpretation, in authentic and popular form, with extensive illustration, of geography in its widest sense, first of Canada, then of the rest of the British Commonwealth, and other parts of the world in which Canada has special interest.

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Beauharnois power development southwest of Montreal which involved the construction of a canal 15¼ miles in length connecting Lake St. Francis and Lake St. Louis. The development utilizes a difference in level of 82 feet between these two lakes. Excluding the powerhouse, designed for the installation of fourteen 50,000 horse-power generating units, or a total of 700,000 h.p., over 65,000,000 cubic yards of material were handled up to December 31, 1935, in excavations. Three railway roadbeds were diverted for a distance of 11.6 miles and also 20 miles of highway. Three steel and concrete bridges were constructed to provide for traffic across the 3,000-foot width of the canal. This photograph by Max Sauer, Jr. illustrates the powerhouse and a section of the canal from the direction of Lake St. Louis.

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The British standard of spelling is adopted substantially as used by the Dominion Government and taught in most Canadian schools, the precise authority being the Oxford Dictionary as edited in 1929.

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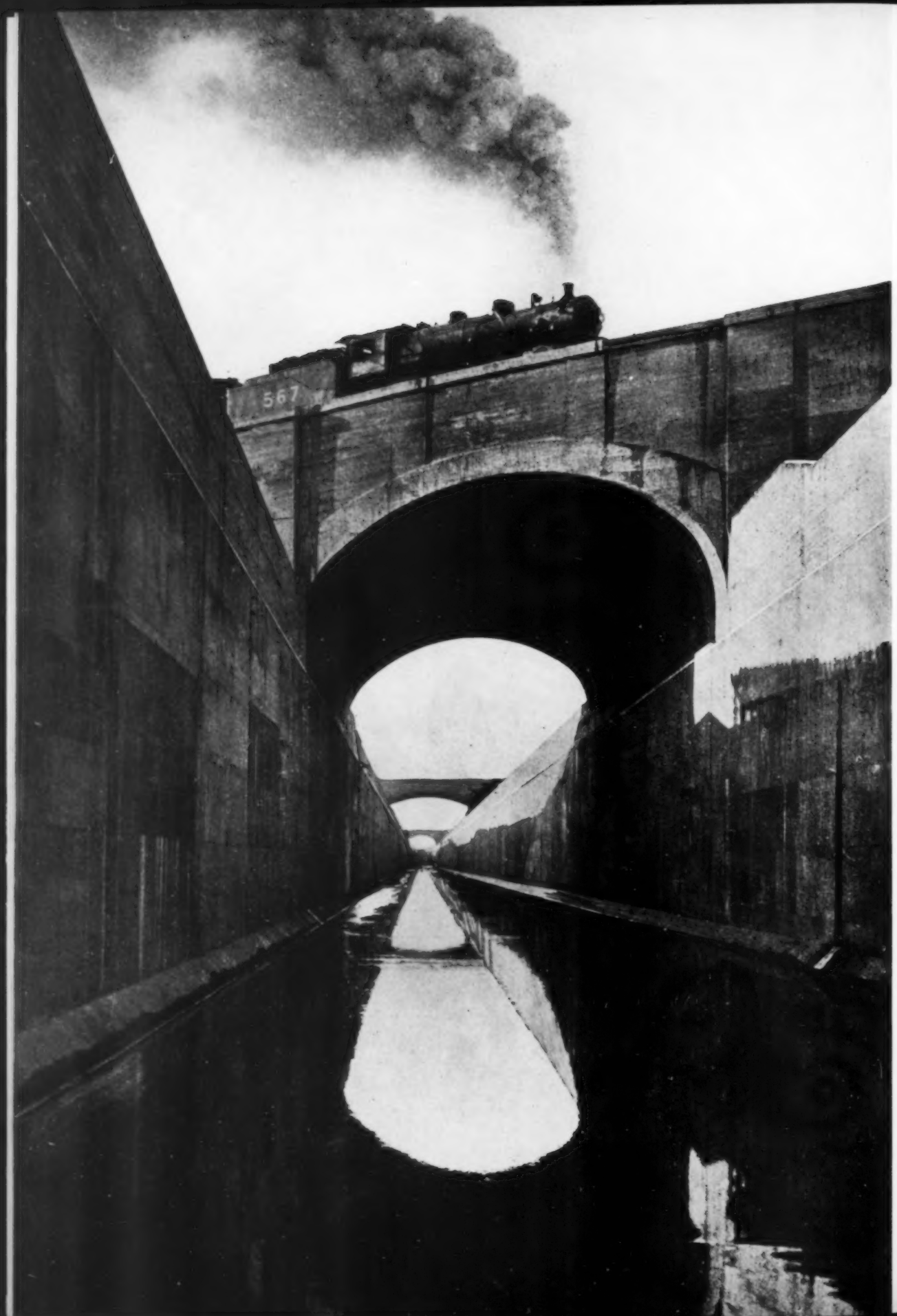
LEFT —Rushing waters through the waste-gate of the Rivière-des-Prairies powerhouse, photographed at daybreak from a point on the north shore; visible in the aerial view on page 120.

Photo by E. J. N. Kennedy.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CANADA'S WATER POWER WEALTH

by J. T. JOHNSTON

OUTSTANDING in Canada's rich endowment of natural resources are her water powers. Nature has been generous in her allotment and distribution of these powers from coast to coast. The wide domain, favourable topography, ample and well-distributed precipitation and innumerable lakes and rivers, all combine to provide a wealth of water power capable of furnishing a dependable flow of low-cost hydro-electric energy to practically every centre of population in the Dominion, and for the development of the industries of mine and forest in our great hinterland. This widespread availability of a low-priced power resource has been the basis of the remarkable development which has taken place since the beginning of the present century, a period which has brought Canada from almost a purely agricultural country to one, also, of outstanding industrial importance.

From the dawn of human life on this planet, man's intelligence has turned to the development of substitutes for man power. In the earliest years he harnessed the animals most easily tamed—a form of power still used as aids to transportation, to agriculture, and in some countries for the turning of wheels in industry. Later in man's progress through the centuries, windmills and simple water-wheels were used to obtain power from the air and water, while during the past two hundred years steam power, internal combustion power, and hydro-electric power have amazingly altered and advanced man's living conditions and multiplied almost immeasurably his ability to produce.

It was well said at the Third World Power Conference, held in Washington, September, 1936, that "Power has become the most efficient tool of the machine age, enormously lessening manual labour and quickening and rendering more efficient almost every productive activity. Its future expansion holds rich possibilities for material well-being and for consequent leisure and cultural advancement."

Power is the basic tool of modern industry. *Low-cost* power is the key to industrial supremacy. *Water Power* is Canada's basic power tool.

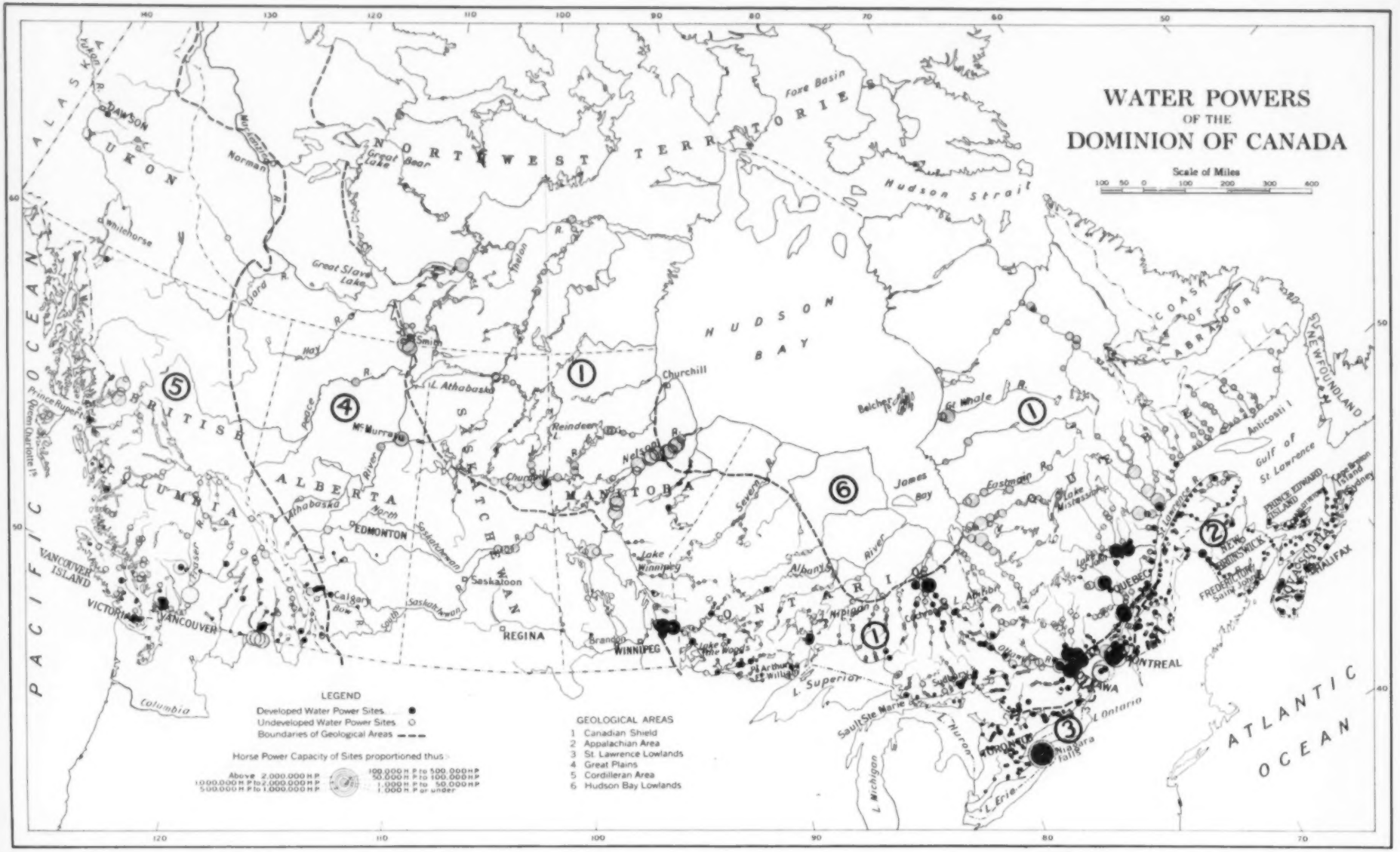
Water power is, furthermore, an instrument or asset which is peculiar as compared with other forms of power in that it is inexhaustible by use. On the contrary it may be said that its only wastage lies in its non-use. No matter to what use it may be put by industries, the supply is constantly renewed by the ever-recurring cycle of evaporation, condensation, precipitation and run-off. Its availability is, however, susceptible of improvement through knowledge of run-off characteristics and by reasonable policies of conservation and regulation.

The power rivers of Canada have an estimated power capacity of some thirty-four million horse-power. This, under normal conditions, would suffice for a turbine installation of nearly forty-four million horse-power, of which about eighteen per cent is now installed. This has meant a direct investment of $1,600,000,000 in the development, transmission and distribution of the power with vastly greater sums in the power-using industries and equipment throughout the Dominion. These rivers have furnished the low-cost motive power so necessary for our mining, metallurgical, chemical, pulp and paper and many other industries.

With these thoughts in mind, there will be outlined very briefly in what follows the outstanding features of Canada's fortunate position in respect to the character, location, extent, development and utilization of her hydro-power resources.

Canada's basic geological formations, with their superimposed topographical features, play a vital part in the initiation and subsequent distribution of precipitation; in the gathering of the resultant run-off into river systems, and in the concentration of the river flow into usable power heads and reservoir sites capable

LEFT:—The magnitude of the 560,000 h.p. Queenston-Chippawa enterprise is illustrated in this view of the power canal which carries the water 12¾ miles from the Niagara River above the Falls to the power station. For 4¼ miles of the canal utilizes the Welland River, the remaining 8½ miles was excavated mostly in rock where the canal is 48 feet wide and the depth of the water averages 35 feet.


WATER POWERS
OF THE
DOMINION OF CANADA
Scale of Miles
100 50 0 100 200 300 400
LEGEND
Developed Water Power Sites
Undeveloped Water Power Sites
Boundaries of Geological Areas
Horse Power Capacity of Sites proportioned thus
Above 2,000,000 H.P.
1,000,000 H.P. to 2,000,000 H.P.
500,000 H.P. to 1,000,000 H.P.
100,000 H.P. to 500,000 H.P.
50,000 H.P. to 100,000 H.P.
1,000 H.P. to 50,000 H.P.
1,000 H.P. or under
GEOLOGICAL AREAS
1 Canadian Shield
2 Appalachian Area
3 St. Lawrence Lowlands
4 Great Plains
5 Cordilleran Area
6 Hudson Bay Lowlands
PACIFIC OCEAN
ATLANTIC OCEAN
HUDSON BAY
Hudson Strait
Fore Basin
NORTH WEST TERRITORIE
YUKON
ALASKA
BRITISH COLUMBIA
ALBERTA
SASKATCHEWAN
MANITOBA
ONTARIO
QUEBEC
NEW BRUNSWICK
NOVA SCOTIA
PRINCE EDWARD ISLAND
NEWFOUNDLAND
COAST OF LABRADOR
Gulf of St. Lawrence
Anticosti I.
DAWSON
Whitehorse
Norman
Great Bear Lake
Great Slave Lake
Mackenzie R.
Liard R.
Peace R.
Hay R.
Thelon R.
Smith
L. Athabaska
Churchill
Reindeer L.
Nelson R.
Churchill R.
Belcher Is.
Great Whale R.
James Bay
Severn R.
Eastmain R.
Lake Mistassini
Lake St. John
Saguenay R.
Ottawa R.
Abitibi R.
Lake Timiskaming
Lake Nipissing
Albany R.
Lake Winnipeg
Lake of the Woods
Winnipeg R.
Red R.
Assiniboine R.
Saskatchewan R.
South Saskatchewan
North Saskatchewan
Athabaska R.
Peace River
Mc Murray
EDMONTON
Calgary
Bow R.
Columbia R.
Kootenay R.
Fraser R.
Prince Rupert
Queen Charlotte Is.
VANCOUVER ISLAND
VICTORIA
VANCOUVER
Saskatoon
REGINA
Brandon
WINNIPEG
Port Arthur
Fort William
L. Superior
Sault Ste Marie
L. Nipigon
L. Abitibi
L. Michigan
L. Huron
L. Erie
L. Ontario
Niagara Falls
TORONTO
OTTAWA
MONTREAL
QUEBEC
Lake St. John
FREDERICTON
Saint John
HALIFAX
SYDNEY
Cape Breton Island
Prince Edward Island

of economic development. The remarkably advantageous distribution of these water-power resources makes feasible the development and utilization of the other natural resources of mine, forest and land from coast to coast. Upon this geological background the water-power resources of the Dominion will be discussed under the principal formations: the Canadian Shield, the Appalachian Area, the St. Lawrence Lowlands, the Great Plains, and the Cordilleran Area. An area known as the Hudson Bay Lowland borders the southern and western shores of James and Hudson bays. This coastal plain is remote, and possesses few water powers except on the lower Nelson river, these lie close to and for the purposes of this article are grouped with the Canadian Shield powers.

The accompanying Water Power map shows the principal developed and undeveloped power sites, and also indicates the general boundaries of the various geological areas.

The Canadian Shield

The area of the Dominion of Canada is approximately 3,695,000 square miles, roughly two-thirds of which lies in the exposed surface of the precambrian continent called the Canadian Shield. This area comprises almost the entire continental portion of Canada lying north of a line starting on the eastern coast and following the northern boundary of the depressed area occupied by the St. Lawrence river, westward to lake Ontario. From this point the line runs westerly to Georgian bay then skirts the north shore of lake Huron and, entering the United States, sweeps around the ancient depressed area occupied by lake Superior to re-enter Canada at the Lake of the Woods, and runs northwesterly to skirt the eastern shore of lake Winnipeg. From lake Winnipeg the line bears northwest to the western end of lake Athabaska and passes through the basins of the Great Slave and Great Bear lakes, reaching the Arctic ocean to the east of the Mackenzie river delta.

The Canadian Shield covers so vast an area that its climate varies from the temperate to the subarctic, and the average annual precipitation varies from 40 inches in the east to 10 inches in the far northwest. In general the topography is confused so that we find innumerable lakes scattered throughout the area, spilling over rock barriers into lakes at lower elevation or descending steeply by rocky streams. For the most part the terrain is impervious and has ample but irregular gradients, so that much of the precipitation appears as run-off because the absorption and transpiration losses are relatively small, although evaporation from the lake areas is substantial in the summer months.

Natural storage reservoirs and water-power sites in such terrain are innumerable and widely distributed while the main rivers, into which drainage finally finds its way, are endowed with outstanding power resources.

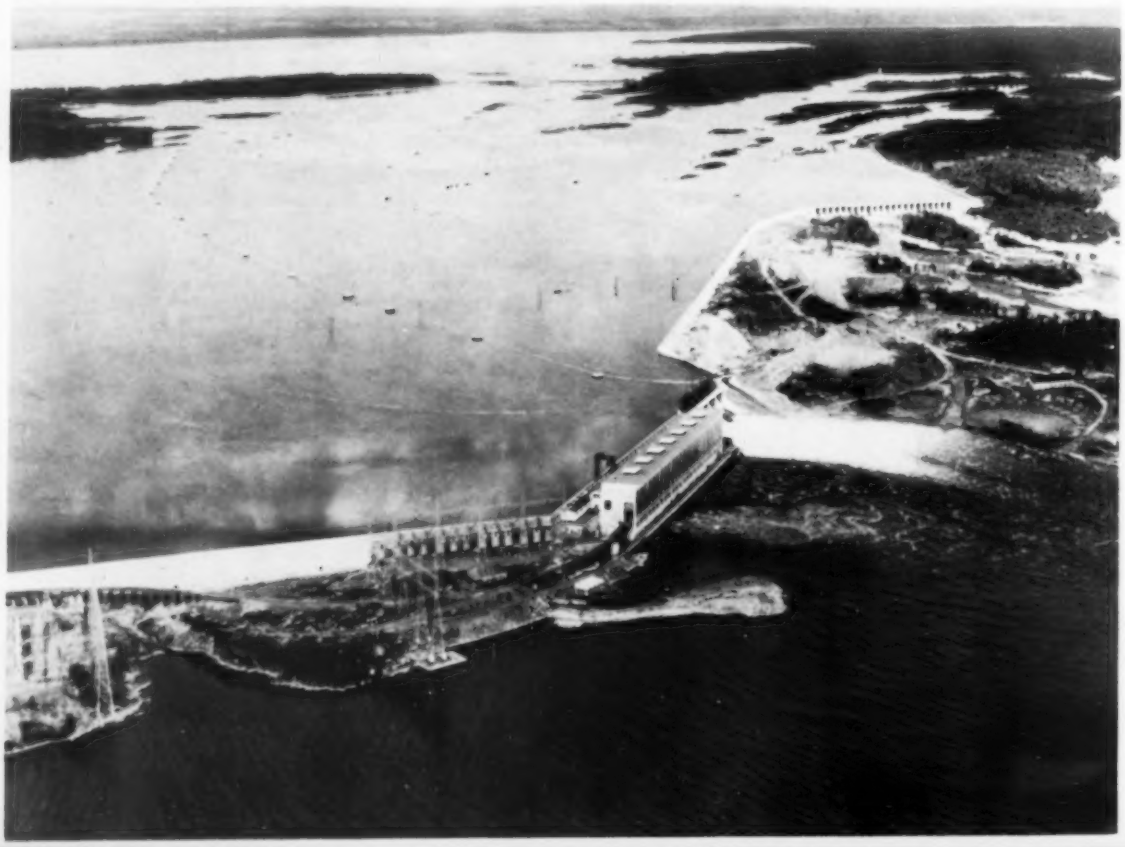
The power resources are greater in the south and east, where the annual precipitation is higher, ranging from 40 inches down to 25, and where the winters are of shorter duration and less intensity. Annual run-off diminishes from around 2.0 to less than 0.5 second-foot per square mile of drainage area. West of lake Winnipeg, where the southern boundary of the Shield runs roughly northwest, diminishing precipitation and longer winters reduce the water-power possibilities. Nevertheless, in many cases lakes make it possible to secure almost complete regulation of run-off so that there are many water-power sites, even within the subarctic areas, capable of producing ample hydro-electric energy for the mining industry which is developing in the Far North.

It is estimated that the water-power resources of the Canadian Shield aggregate almost 20,000,000 horse-power, warranting a total turbine installation of probably 26,000,000 horse-power. At the present time the installed capacity of water-power plants throughout the Shield totals 4,600,000 horse-power, or about eighteen per cent of the available resources. The power rivers in this great area are too numerous to discuss in detail and it is possible only to mention a few of the more outstanding:

The Churchill and Nelson, in addition to the supply from the Canadian Shield, receive drainage from the Cordilleran slopes and the Great Plains, and pour into northern Saskatchewan and Manitoba, a power capacity of 3,000,000 to 4,000,000 horse-power. A 61,500 horse-power development at Island Falls on the Churchill provides the means of operating the great Flin Flon ore deposits.

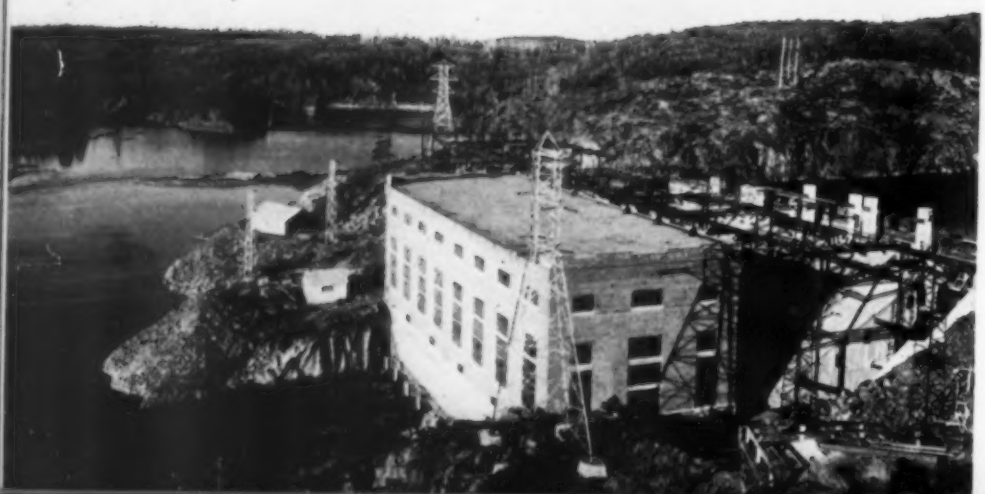
Abitibi Canyon power development, on the Abitibi River, indicating powerhouse in the gorge and flood discharge sluices to the left. This was acquired in 1933 by the Ontario Government while under construction, and completed in 1935 by the Hydro-Electric Power Commission of Ontario with an aggregate installation of 330,000 h.p.

Power development at Chats Falls, on the Ottawa River, indicating the main dam, powerhouse and Chats Lake in the background. This plant is owned jointly by the Hydro-Electric Power Commission of Ontario and the Ottawa Valley Power Company, and has a capacity of 230,000 h.p.



Aerial view of the Cedars Rapids power development of the Montreal Light, Heat & Power Consolidated (in centre), and the St. Timothée development of the Canadian Light & Power Company (lower right). The former, which has an installed capacity of 206,400 h.p., serves the City of Montreal, while the latter, having a capacity of 28,800 h.p., serves the surrounding district, which includes the municipalities of Valleyfield, Huntingdon and Beauharnois.

Downstream side of the Cameron Falls development on the Nipigon River, Ont., from which Fort William and Port Arthur derive their power requirements. This aerial view portrays the trail-race, powerhouse, main dam and headpond.



(Upper)—Part of Drummondville, on the St. Francis River, Que., and the 19,500 horsepower plant operated by the Southern Canada Power Company, Ltd.

(Centre)—Aerial view of 45,000 h.p. station established on the Rivière-des-Prairies (Back River) by the Montreal Island Power Company. It was placed in production in November, 1929.

(Lower) — Mining operations in the northwestern section of Quebec province are served by the Canada Northern Power Corporation from a plant of 40,000 h.p. on the Quinze River.

The Winnipeg river lying upon the fringe of the Shield, with potential capacity of over 1,000,000 horse-power already supplies through seven power stations, publicly and privately-owned, some 359,000 horse-power for the operation of mining districts, of pulp, paper and flour mills, and of industry and public distribution in general, in northwestern Ontario, in the city of Winnipeg and throughout southern Manitoba.

Eastwardly, the Shield supplies the basic hydro-power for the development of the great mineral and timber wealth of northern Ontario and Quebec. Mention may be made of the 3,400,000 horse-power of the Albany, Mattagami, Abitibi, Harricanaw, Nottaway, Broadback, Rupert, Big and Eastmain rivers flowing to Hudson bay; of the 210,000 horse-power of the Kaministikwia and Nipigon rivers, supplying the Fort William and Port Arthur area on lake Superior; of the 2,450,000 horse-power of the Gatineau, Lievre, St. Maurice and Saguenay rivers, flowing southward from the Shield to the St. Lawrence; of the 1,310,000 horse-power of the Ottawa, three-quarters of which lies within the Shield, and of the 2,400,000 horse-power of the Bersimis, Outardes, Manikuagan and other great rivers entering the St. Lawrence east of the Saguenay.

These vast resources of low-cost energy available in the Shield constitute the foundation of development and progress within and beyond the areas immediately adjacent to the rivers named.

Hydro-power gives life to northern Ontario's rich deposits of silver in the Cobalt area; of gold in the Porcupine and Kirkland Lake areas, and in the Little Long Lac, Red Lake, Pickle Crow and other newer areas; of nickel and copper in the Sudbury area. It processes imported iron ore at Sault Ste. Marie and feeds the great pulp and paper mills of Iroquois Falls, Smoothrock Falls, Kapuskasing, Sault Ste. Marie, Port Arthur, Fort William, Fort Frances and Kenora.

In northern Quebec these powers provide the energy for operating the flourishing copper-gold mines at Noranda, and the gold properties in adjacent territory; the great electro-metallurgical and chemical industries of Shawinigan Falls; the immense aluminum industry at Arvida, where the magnet of low-priced power draws raw material from British Guiana to serve a world market. They feed the pulp and paper mills at Timiskaming, Hull, Gatineau, Buckingham and Masson, at Grand' Mère, Shawinigan Falls and Three Rivers, at Donnacona, Quebec, River Bend, Kenogami and Chicoutimi. In addition, these water resources of the Shield contribute large quantities of power for transmission and local distribution as far south as the Niagara district in Ontario, to the city of Montreal, to the Eastern Townships, and as far east as Murray Bay.

Truly the hydro-power of the Shield is an asset incalculable—an asset which is self-perpetuating, one which renders its greatest value through utilization, and one to be conserved by intelligent regulation.

The Appalachian Area

South of the Canadian Shield in the east is the Appalachian region, comprising roughly the Maritime Provinces and Eastern Quebec south of the St. Lawrence. Altitudes of 3,500 feet are reached in the Gaspé peninsula and 2,000 feet in southeastern Quebec and northern New Brunswick, but for the most part the area is less than 1,000 feet above sea level. The territory is drained by numerous rivers, many of which are short, with relatively small catchment areas, but with steep descents from the interior highlands. Precipitation is about 55 inches per annum on the Atlantic seaboard, diminishing to about 45 inches in the western portion. Facilities for the creation of storage reservoirs are found in the higher lands, while the steep descents afford many water-power sites of moderate capacity.

The combination of relatively impervious terrain, high precipitation, and good gradients produces high run-off, averaging on the larger watershed about 2.5 second-feet per square mile and in some cases as much as 4.0 second-feet per square mile in the eastern sections. Farther to the west less precipitation produces a somewhat lower average run-off of from 1.75 to 3.0 second-feet. The mean run-off for the Saint John river, the largest traversing this region, is over 1.5 second-feet per square mile for 15,300 square miles of drainage area.

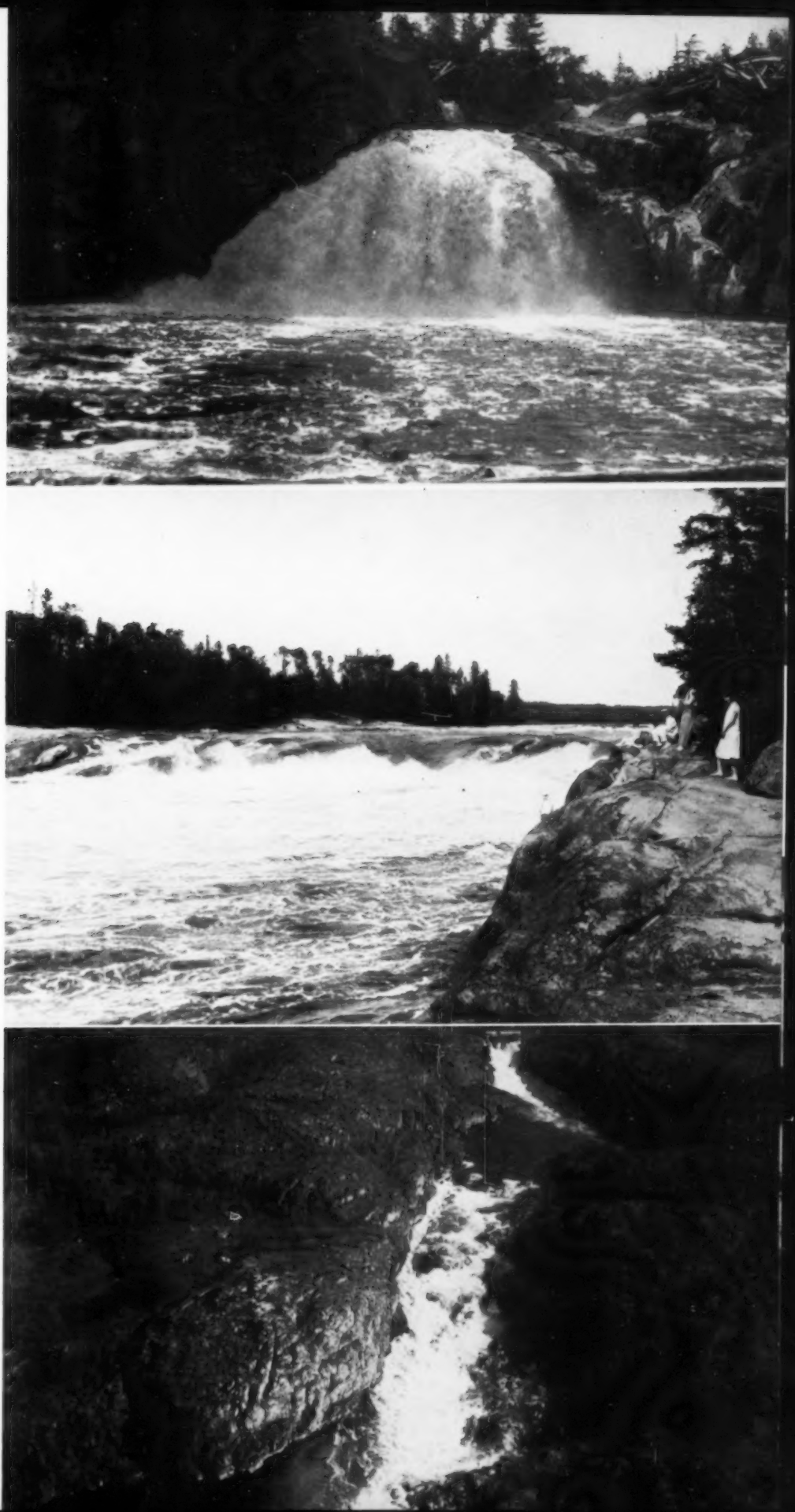
The Appalachian area includes hydro-power resources totalling 550,000 horse-power, which would sustain a turbine installation of about 700,000 horse-power. An extensive development has already taken place aggregating more than 400,000 horse-

Vast undeveloped water-power resources exist throughout the Dominion. Of an estimated 26,000,000 horsepower in the Canadian Shield, the installed capacity of plants already established totals only 4,600,000 h.p., or about eighteen per cent of the available supply.

(Upper)—Alexandra Falls, on the Hay River, in the Northwest Territories.

(Centre)—Whitemud Falls, on the Nelson River, Man.

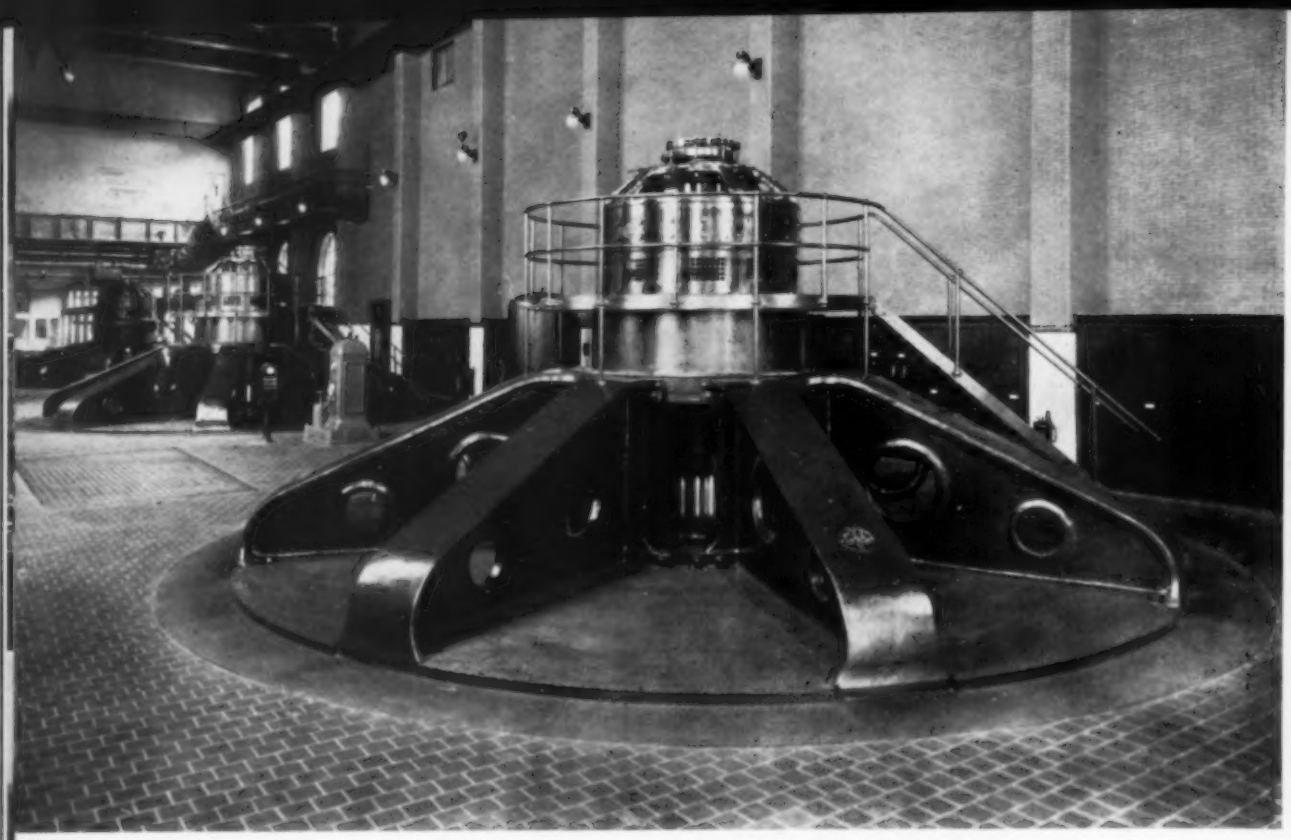
(Lower)—Wiachauan Falls, on the river of that name, Ungava.



(Upper)—High Falls on the Blanche River, a tributary of the Ottawa River in Quebec.

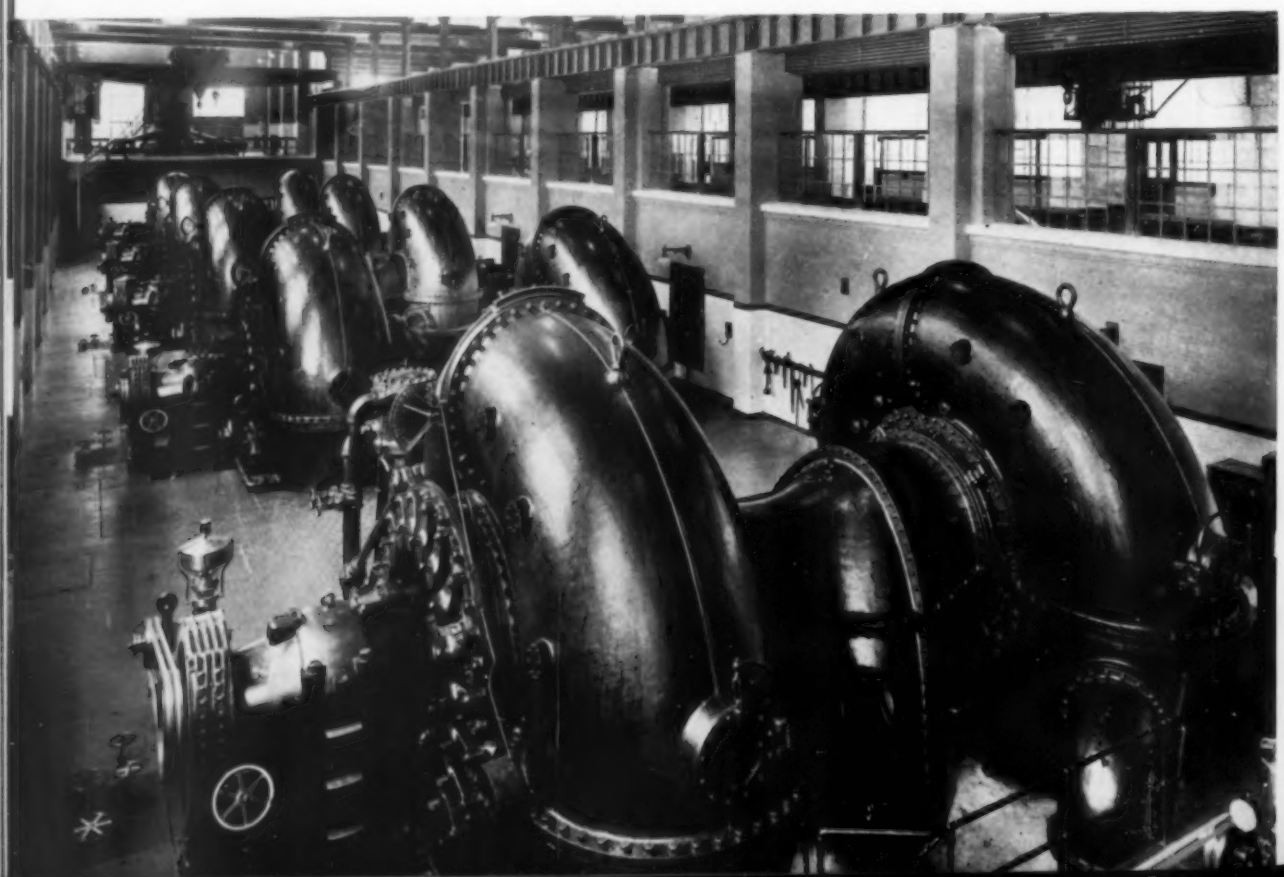
(Centre)—Whitedog Falls on the Winnipeg River in Ontario.

(Lower) — Harvey and Anderson Falls on the Lockhart River, a tributary of Great Slave Lake in the Northwest Territories.



With the completion, in 1929, of the three powerful generators here illustrated, hydro-electric development of The Shawinigan Falls Water & Power Company at Shawinigan Falls reached its present figure of 333,000 h.p. The two generators in the foreground each have a capacity of 43,000 h.p., while the third has a capacity of 41,000 h.p.

Five horizontal turbines installed in one of the powerhouses of The Shawinigan Water & Power Company at Shawinigan Falls, Que. These turbines are rated at 18,500 h.p. each, and are of the double-runner type.



Chelsea and Farmers hydro-electric plants of the Gatineau Power Company, located on the Gatineau River seven miles north of its junction with the Ottawa River. These stations have a combined designed capacity of 290,000 h.p. Farmers is in the foreground.

Photos by R.C.A.F.

Plant of the Gatineau Power Company at Paugan Falls, near Low, Que., and 36 miles above the mouth of the Gatineau. It has a designed capacity of 272,000 horsepower, and operates under a head of 136 feet. The power is transmitted 230 miles to Toronto over one of the largest transmission lines in the world.

power. Of the power rivers worthy of special mention, the Mersey in Nova Scotia has substantial resources and an extensive present development; the Saint John in New Brunswick is a power river of major proportions; while the St. Francis river in Quebec, lying in the western fringe of the area, has power resources of magnitude, much of which is now developed.

Industrial progress and domestic comfort, based upon low-priced hydro-power, have contributed greatly to the economic and social progress of the area. Hydro plants serving the publicly and privately-owned transmission and distribution systems of Nova Scotia, New Brunswick and Eastern Quebec, as well as privately controlled industrial enterprises, provide substantial supplies of power for industry and for domestic use throughout the Appalachian territory. Most of the leading municipalities and industrial centres of the Maritimes and Southeastern Quebec are served with hydro-power. Major pulp and paper enterprises are supplied at Liverpool, Nova Scotia; Edmundston and Dalhousie, New Brunswick; and Windsor Mills, Bromptonville and East Angus, Quebec; while the famous asbestos mines of the Eastern Townships of Quebec are also hydro operated.

The St. Lawrence Lowlands

West of the Appalachian region are the St. Lawrence Lowlands, an area of 35,000 square miles extending from a short distance below Quebec city to lake Huron, south of Georgian bay. The Great Lakes and the St. Lawrence river are the outstanding drainage features of the area, with such principal tributaries as the Trent in Ontario, the lower Ottawa on the boundary between Ontario and Quebec and the Richelieu in Quebec. Precipitation varies from 30 to 40 inches per annum.

The water-power resources of the Lowlands, estimated at more than 6,000,000 horse-power, are found principally on the Niagara, St. Lawrence and lower Ottawa rivers with powers of lesser magnitude on the Trent, Richelieu and other tributaries. The total present development is almost 2,000,000 horse-power while substantial quantities of power are brought into the Lowlands from rivers in the adjacent Canadian Shield and Appalachian area.

The Niagara, under present treaty limitations, already produces and makes available for distribution in Canada a total of 800,000 horse-power with complete protection of the great scenic values of Niagara Falls. Upon this great development is founded the vast industrial structure of southern and western Ontario with its flourishing cities, while the domestic comfort resultant from the widespread application of low-cost hydro-energy to lighting and home use in city, town and countryside, has been immeasurably increased.

The St. Lawrence river alone carries a power potentiality of 5,000,000 horse-power, of which some 4,000,000 horse-power are wholly located in Canada. This vast power, lying adjacent to the heart of the industrial provinces of Ontario and Quebec, constitutes an asset of almost incalculable value to the future of the Dominion.

On one hand the Great Lakes and St. Lawrence waterway ensure cheap water transportation for all that portion of Canada's immense natural resources located in the St. Lawrence and Great Lakes watershed, extending across half the continent, thereby making these resources directly accessible to the productive application of the St. Lawrence power. On the other hand the power lies close to deep water navigation from Montreal to the sea, making directly accessible and available the trade routes and markets of the world for the disposal of the resulting products. The combination of natural resources, low-cost power and accessibility to market cannot fail to make the lower St. Lawrence valley in Canada one of the great industrial and distributing centres of the world.

The Great Plains

The Great Plains occupy in Canada a roughly triangular area with its base on the international boundary and its apex on the Arctic ocean at the mouth of the Mackenzie. It is bounded on the east and north by the Canadian Shield, and on the west by the easterly range of the Cordilleran area which forms the western portion of the continent. The Plains are overlaid with great depths of soil, through which streams cut themselves down into deep coulees and the rivers into deep, wide valleys. The rivers and streams flow generally with gradual gradient and few rapids or falls occur. Precipitation varies from around 20 inches per annum in the east to 10 inches or less in the south and west, and the pervious terrain and slight

gradient is unfavourable to a high run-off factor which, in the purely plains rivers, is generally below 0.1 second-foot per square mile.

Some of the larger rivers, such as the Saskatchewan, which have their source in the Cordilleran area, have average annual run-off of between 0.15 and 0.2 second-foot per square mile, but the main water-power resources available for the plains are those located near its borders, either in the Cordilleran or Canadian Shield regions.

The southern plains, from their very nature, have not the geological structure which makes for the concentration of river flow into natural heads suitable for the development of power. In the northern areas, however, on such rivers as the Saskatchewan, Athabaska, Peace and Slave, rapids occur which offer possibilities of substantial development. Throughout the Great Plains it is estimated the water-power resources total 1,800,000 horse-power.

While the southern plains are lacking in water powers capable of economic development they have a rich endowment of adjacent hydro-power resources—in the east and north along the borders of the Canadian Shield and in the west from the slopes and foothills of the Cordilleran region.

Already power from the Winnipeg river reaches all southern Manitoba, while undeveloped power on the Churchill and Nelson rivers provides an enormous reservoir for the future supply of northern Manitoba and Saskatchewan. Power from the Bow river, originating in the snow fields and glaciers of the Rocky mountains, now serves a large part of Alberta through a network of transmission lines, and other powers in the mountain and foothill slopes are available for future development. The publicly and privately owned hydro-power enterprises of the Prairie Provinces have already nurtured a wide utilization of these adjacent water-power resources

The Cordilleran Area

The Cordilleran area consists of three roughly parallel mountain ranges, the eastern comprising the Rocky and Mackenzie mountain ranges, the central belt comprising a series of plateaus and mountains, while the western belt, lying west of the plateau country, comprises the coastal and insular mountain ranges.

It is difficult to generalize briefly concerning the water powers of the Cordilleran area because topographic and climatic conditions vary so greatly. On the eastern slope of the Rocky mountains melting snow from the higher levels produces run-off varying between 2.0 and 0.5 second-feet per square mile of drainage area. Low-head sites are found on the main rivers, with high head combined with storage sites on their tributaries. Combinations of these afford promising opportunities for developing dependable hydro electric resources. On the western slope of the Rocky mountains and the eastern slope of the central range, streams are short and swift, and many high-head power sites exist but few are of large capacity, the chief power sites being on the Bull and Elk rivers in the southern section of this area. In the central belt of plateaus and mountains, run-off intensity varies between wide limits from around 1.0 to upwards of 3.0 second-feet per square mile, water-power resources are large but the principal sites are on the main rivers which flow in the valleys and collect the flow of numerous tributaries. The western belt of the Cordilleras including the coastal and insular mountain ranges experiences heavy precipitation, in the higher altitudes exceeding 100 inches per annum, and mean annual run-off as high as or higher than 10 second-feet per square mile. This run-off with the numerous high heads available affords many opportunities for power development, particularly where storage and concentration of flow of several smaller streams by diversion can be secured. In addition to the high-head plants on the smaller rivers there are valuable opportunities on some of the larger streams such as the Fraser and Skeena, which drain substantial portions of the central plateau before breaking through the coastal range to reach the Pacific ocean.

The water-power resources of the Cordilleran area have been estimated at 5,200,000 h.p., warranting a turbine installation of some 6,800,000 horse-power. Detail studies of the run-off characteristics, of the possibilities of storage, of diversions from one watershed to another, and the development of high heads, will unquestionably greatly increase this figure.

The hydro-energy has had widespread application to the development of other rich resources of the district. Hydro-power from the Klondike river drives the

Water power, in conjunction with such natural resources as timber and minerals, has resulted in the establishment of communities in various sections of the Dominion. The northwestern section of Quebec Province is served by the Quinze River plant of the Canada Northern Power Corporation, having a capacity of 40,000 h.p., including the thriving town of Noranda (upper). Sudbury, Ont., formerly no more than a railway divisional point, has attained prominence through development of great nickel-copper resources with the aid of hydro-electric energy from plants on the Spanish and Wanapitei Rivers (centre). Ear Falls development on the English River (lower) is being increased this year to 10,000 h.p. by the Hydro-Electric Power Commission of Ontario. It furnishes power to the Red Lake mining district, and also controls the level of Lac Seul, thereby regulating the flow of the English and Winnipeg Rivers.

Photos by R.C.A.F.

Canada's pulp and paper industry have prospered in large measure by reason of the wealth of water power available for the various operations involved in transforming spruce into another form. The City of Three Rivers, Que. (upper) has an additional advantage in that ocean vessels may sail up the St. Lawrence to berth alongside her mills, there loading supplies for all parts of the world. Adjacent shallow draft navigation facilities are available to the Canadian International Paper Company's plant at East Templeton, on the Ottawa River (centre), which secures its power from the Farmers Rapids, Chelsea Falls and Paugan Falls' development of the Gatineau Power Company, brought into operation in 1927-1928, and later enlarged to a capacity of 470,000 h.p. Illustrating the development of new industry in a formerly uninhabited area, the Manitoba Pulp and Paper Company's mill (lower) derives its power from the plant of the Winnipeg Electric Company at Great Falls, Man., having a capacity of 168,000 h.p.

Photos by R.C.A.F.

Hydro-electric development at Chute-à-Caron, on the Saguenay River, of the Alcoa Power Company, Ltd., which provided for the installation between 1931 and 1934 of 260,000 horsepower.

The Churchill River, traversing northern Saskatchewan and Manitoba, has many falls which guarantee ample hydro-electric power for future development. Already Island Falls on this river supplies power to operate the copper resources of the Flin Flon area. This view shows Kettle Falls, a few miles upstream from Island Falls.

great placer gold mining dredges of the Yukon Territory. In the far south, 232,000 horse-power from the Kootenay river forms the foundation of the immense mining, metallurgical and electro-chemical operations at Trail, with their production of zinc, lead and fertilizer meeting the needs of world markets. In Fernie district, in the southeast, and on Vancouver island, we find hydro-power operating coal mines, while along the coast hydro-power operates great pulp, paper and lumber mills at Powell River, Ocean Falls, and other points.

The development of water power in the Cordilleran area has grown very rapidly, and there is now a total installed capacity of 737,000 horse-power. An exceptionally wide municipal and local distribution exists in the Vancouver, Prince Rupert, Kamloops, Revelstoke, Nelson and Fernie districts, carrying the comforts of electric conveniences to a numerous population. Vancouver island, with the capital city of the province, Victoria, and Nanaimo, is well served with hydro-power.

The Central Electric Station Industry

Possibly the most impressive illustration of what her water-power resources mean to Canada is found in the Central Electric Station industry, that is to say, the industry comprising all public and private organizations developing electric energy for distribution and sale throughout the Dominion —an industry which is the nerve centre of our national life. A widespread transmission and distribution system carries the electric energy from the strategically located hydro-electric stations to the centres of population and to the more remote districts, where the resources of mine and forest are being processed into the industrial and commercial life of the Dominion.

Following the introduction of long distance transmission of electricity in the last decade of the nineteenth century, the industry has expanded in Canada until now, at the end of 1936, it embraces a total installation of 6,982,541 horse-power, an annual production of more than twenty-five billions of kilowatt hours, with a total investment of one billion, four hundred million dollars. The low rates at which this power has been made available have resulted in a per capita use of electricity as great or greater than that in any other country.

These figures are illustrative of the immensity of the industry and, in conjunction with them, it is only necessary to state that more than ninety-eight per cent of the entire output is produced from hydro-power, to indicate the almost startling degree to which Canada is depending upon her water-power resources.

The Pulp and Paper Industry

An almost equally striking illustration of the fundamental importance of water power in Canada's economic structure is furnished by the pulp and paper industry. The production of pulp and paper is Canada's greatest manufacturing industry. Its gross and net values of products and its disbursements for salaries and wages exceed the corresponding figures for those of any of the other manufacturing industries, while the output of newsprint is now approximately four times that of any other country, and represents forty per cent of the world's production. Canadian exports of newsprint aggregate seventy per cent of the world's export of that commodity.

The manufacture of newsprint calls for one hundred horse-power of mechanical installation for each ton of daily output. Hence, an ample supply of power is essential to the industry. Mills are located in the Maritime Provinces, Quebec, Ontario, Manitoba and British Columbia. Some develop their own water power but a large majority purchase their requirements from central electric stations. As a whole they absorb more than fifty-five per cent of all power sold for industrial purposes. The total hydro-power used is one million six hundred thousand horse-power.

It is the fortunate location of ample supplies of low-priced hydro-power in close proximity to great supplies of pulpwood that has placed Canada in the leading position she occupies in this industry, and which has enabled her mills to compete so successfully in the world's market.

The Mineral Industries

Turning to the mineral industries we have further impressive demonstration of the influence of water-power. The mineral production of Canada in 1936 was about five and a half times the production during the first year of the present century. It was valued at about $361,000,000. The industries to-day play an outstanding part in Canada's national economy.

Bryson hydro-electric development of the Gatineau Power Company on the Ottawa River, 66 miles west of the federal capital. This plant is one of interconnected group having a total installed capacity of 279,000 h.p., and operates under a head of 57 feet. The power is distributed in Ottawa, Hull and in Eastern Ontario.

Here again water power makes its contribution in no small measure to successful development. We find that, almost without exception, ample resources of hydro-power are economically adjacent to mineral deposits and centres of mining activity. It is not possible in the compass of this article to give even a partial list of the mines and of the industries to which they give rise, and which are dependent upon hydro-power for their operation. Reference may be made, however, to the gold mining in the Yukon; to the vast mining, smelting, and fertilizer industries centred at Trail, British Columbia; to the copper mining on the Manitoba-Saskatchewan boundary; to the gold, silver, and nickel-copper mining operations in northern Ontario; to the gold, gold-copper and asbestos mining operations in Quebec; to gold mining in Nova Scotia; to the electro-chemical and metallurgical operations at Shawinigan Falls, Arvida and Niagara; to iron and steel mills at Sault Ste. Marie, Hamilton, and Port Colborne—all using hydro-power.

During 1936, approximately three billion kilowatt hours of electrical energy were consumed for mining and metallurgical purposes, nearly 95 per cent of which was purchased from Central Electric Stations, and was almost entirely water power. Altogether in the mineral industries of Canada, energy requirements are in excess of 1,000,000 horse-power, of which over 85 per cent is derived from hydro-electric developments.

A feature of hydro-power which is not so generally recognized has to do with utilization of low-grade ores. The value of any ore is measured by the excess of value of the product over the cost of production. Low-cost power gives economic value to low-grade ores. Outstanding, therefore, is the great volume of ore of the lower grades which is profitably mined in consequence of the low cost of hydro-power, and whose otherwise unavailable wealth has thereby added immeasurably to the Dominion's active assets.

In concluding this article, brief reference —partly recapitulation—may be made to some of the outstanding features of Canada's water-power assets and their relationship to her economic structure.

The full measure of the value of water power to Canada cannot be gathered from statistics alone. Its outstanding value lies in the comparatively even distribution, from coast to coast, of ample power that can be economically developed near centres of industry, rather than in the total amount of the power resources in the whole Dominion, large and impressive as that figure is. Its further signal national utility arises from the low cost at which this favourably located power can be made available.

It is of interest to record that:—

Water power supplies more than ninety-eight per cent of the electrical energy utilized in the Dominion.

It furnishes the low-cost motive power so necessary for the exploitation of our mining, metallurgical, chemical, pulp and paper, and many other industries.

It has brought entirely new communities into being, such as Shawinigan Falls and Arvida, in the Province of Quebec.

It has brought to more than sixty per cent of our population the boon of electricity for light and for the many labour-saving devices which so greatly ameliorate our living conditions to-day.

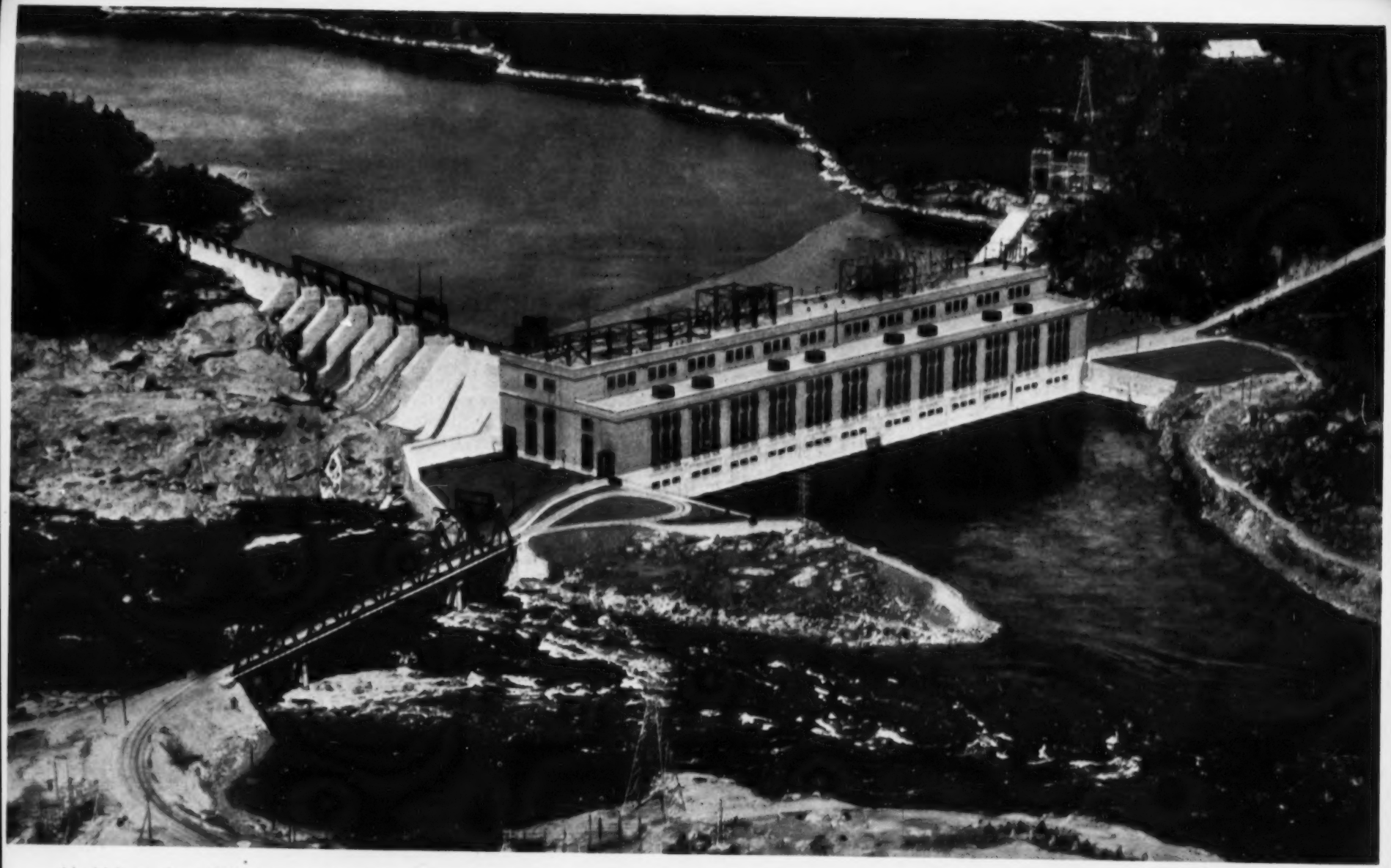
It is penetrating extensively into our rural districts bringing to the farm dwellers the conveniences and comforts already enjoyed by our urban population.

It has saved the consumption of millions of tons of fuel annually, much of which we would have had to import from abroad.

In short, in little more than three decades, this great development of water power has resulted in Canada passing from almost a purely agricultural country to one that is also of first-ranking industrial importance.

To an increasing degree, low-cost power has been a magnet drawing to the Dominion from abroad important industries whose output goes to augment Canadian export trade. Hand-in-hand with this industrial development the widespread distribution of power for domestic use has, in innumerable ways, effected a decided increase in the comfort of living for the mass of the population.

Aerial view of the latest plant brought into operation by The Shawinigan Water & Power Company at Rapide Blanc, Que., in 1934. It is located fourteen miles from La Tuque, on the upper reaches of the St. Maurice River, in almost virgin territory. This picture illustrates the manner in which pulpwood logs are handled on reaching the power plant. The special chute devised for passing logs safely and without damage past the development is seen in the centre.



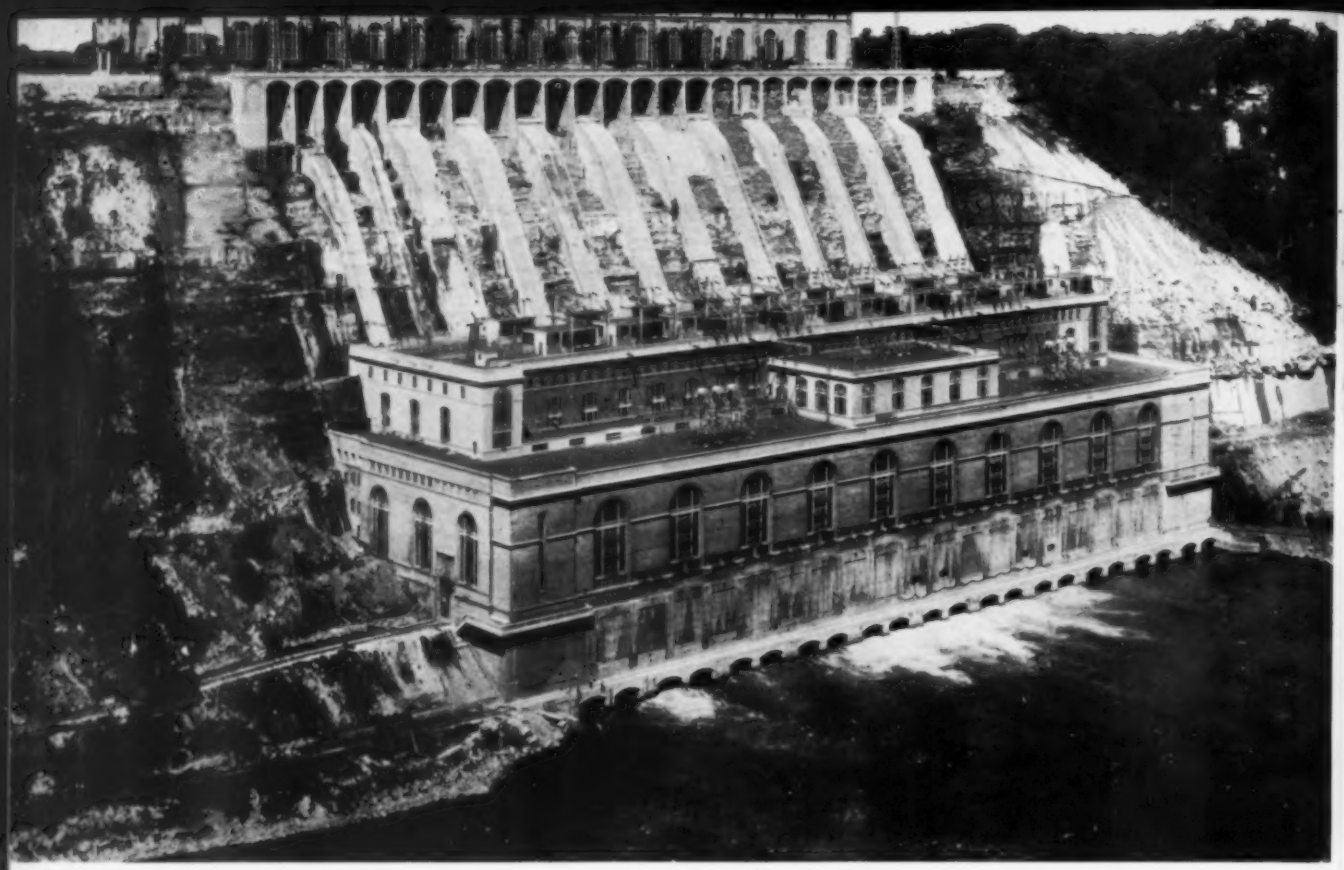
Isle Maligne plant, of the Saguenay Power Company, which derives its 540,000 horse-power from the Saguenay River. This is transmitted at 187,000 volts, 154,000 volts, 110,000 volts, 66,000 volts and 13,000 volts throughout the Saguenay Valley and also to Quebec City. Much of the power is utilized by the Aluminum Company of Canada at Arvida. The plant commenced operation in 1925, having been established by the Duke-Price Power Company.

Power developments at Shawinigan Falls. In the centre foreground is No. 2 powerhouse, with a capacity of 219,500 h.p. To the left is No. 1 powerhouse, having a capacity of 58,500 h.p., and in the vicinity is additional hydraulic development of 55,000 h.p. for the Aluminum plant at the left of the photograph. Regulating dams are at the head of the falls.

La Gabelle plant of The Shawinigan Water & Power Company, situated on the St. Maurice River eight miles above the town of Shawinigan Falls. The plant has an installed capacity of 152,000 h.p., and operates at a head of 65 feet.

Laurentide power development of The Shawinigan Water & Power Company at Grand'Mere, Que., the present capacity of which is 189,000 h.p. On the left may be seen the newsprint mill and board mill of the Consolidated Paper Corporation, and also the beautiful town of Grand'Mere.

St. Narcisse power development of The Shawinigan Water & Power Company, situated seventeen miles northeast of Three Rivers, Que. Only the head-gates and dam are here indicated, the former being connected with the power plant by a tunnel of 4,000 feet, carved out of solid rock. The plant has a capacity of 22,200 h.p., transmitted to Three Rivers over one of the earliest transmission lines in the British Empire.



Queenston-Chippawa power development at Niagara, of the Hydro-Electric Power Commission of Ontario. This plant was
The length of the powerhouse, which contains ten main units and two service units, exceeds 590 feet, and operates under a head
River flows off

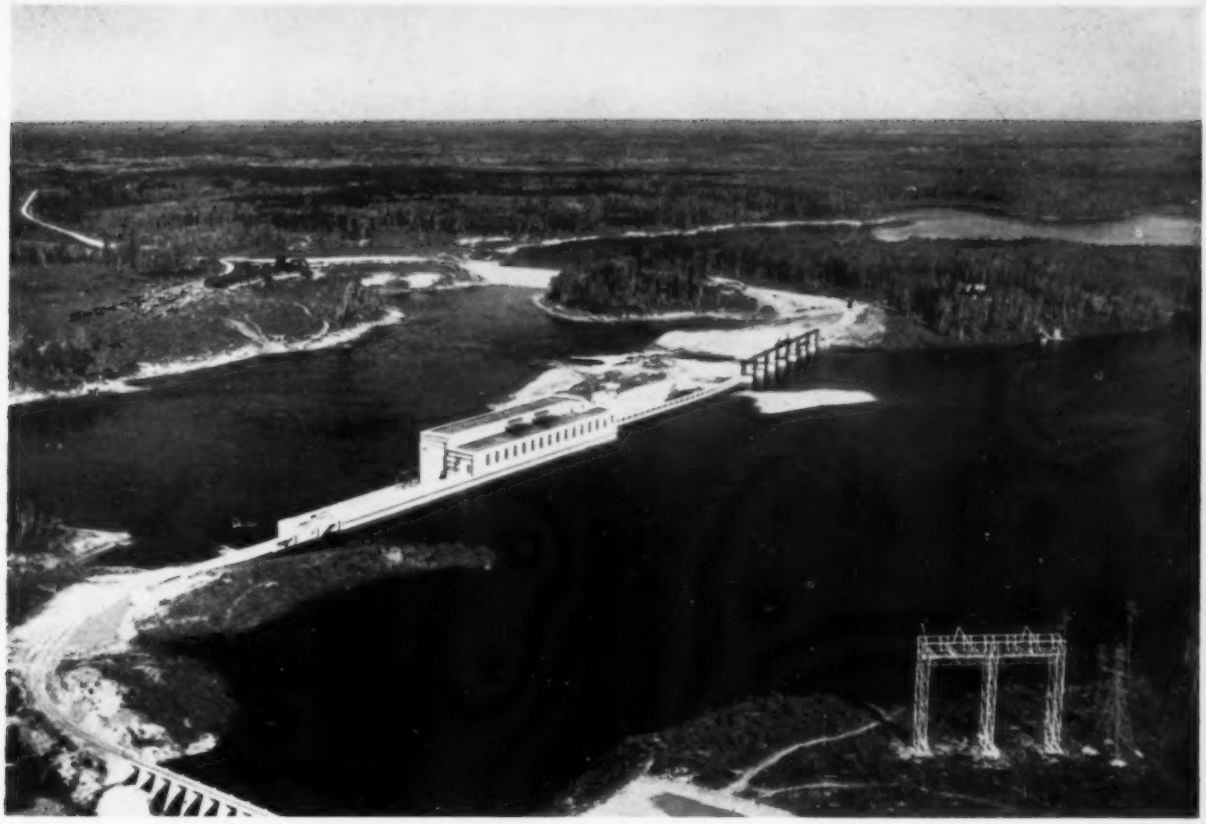
Powerhouse at Cameron Falls, on the Nipigon River, Ont., one of two established on that stream by the Hydro-Electric Power
Alexander Falls, power is transmitted to Fort William and Port Arthur, and also to the gold-mining territory

started in 1917, brought into operation during 1922, and finally completed with an installed capacity of 560,000 h.p. in 1930. of 294 feet. If set in front of the American Falls, they would be practically concealed by this structure. The lower Niagara to the right.

Commission of Ontario. It was brought into operation in 1920, and later enlarged to 75,000 h.p. From this and the plant at east of Lake Nipigon. This photograph illustrates the upstream side of the powerhouse and main dam.

The intimate relation of water-power to the pulp and paper industry is well illustrated in this photograph of the mill of Price Bros. & Company on the Ausable River, Kenogami, Que. The dam and headworks are seen in the centre of the picture, with the penstock leading therefrom to the powerhouse, in the right lower corner. The transmission line may be detected leading from the powerhouse to the mill in the upper left portion of the picture.

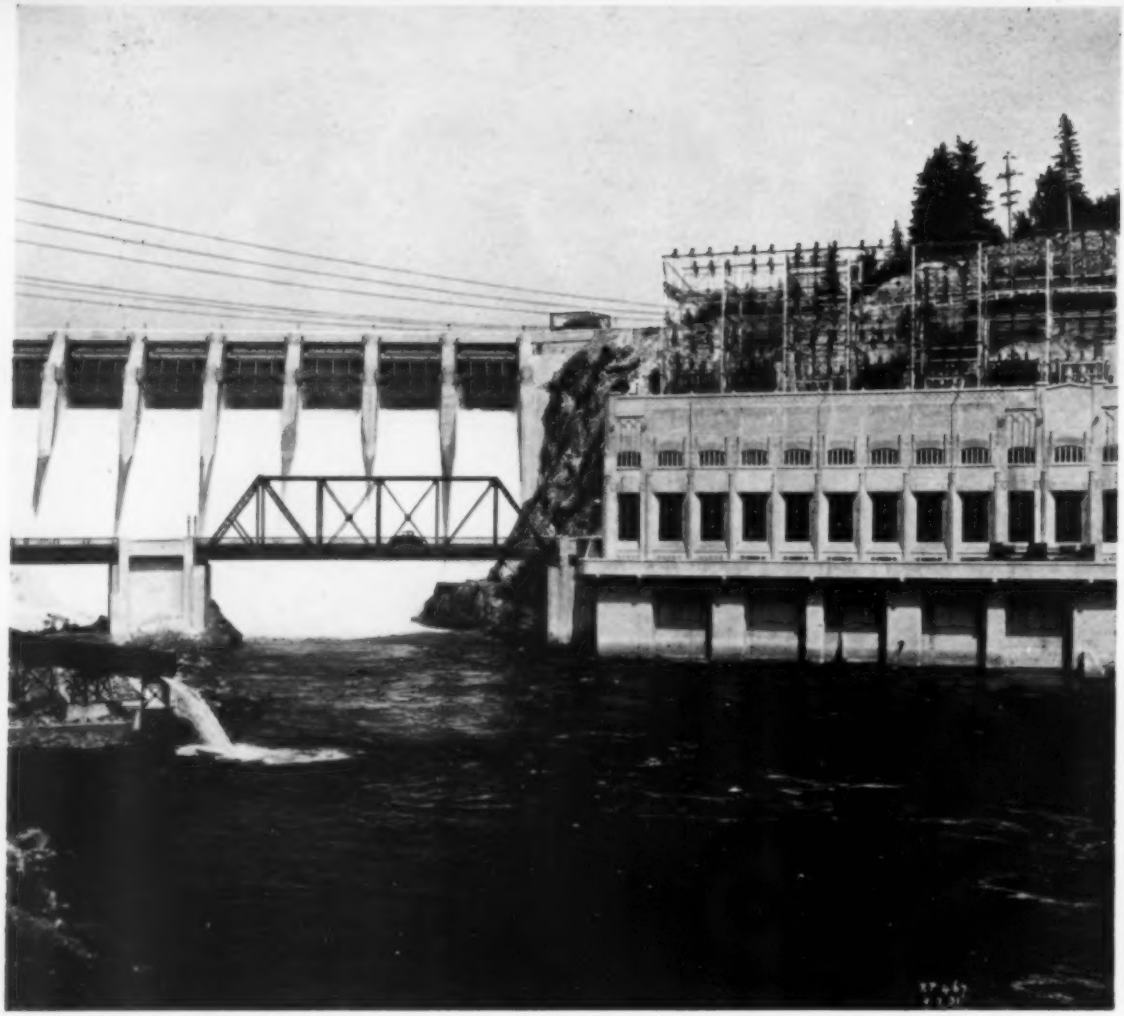
Completed in 1928 at Smoky Falls, on the Mattagami River, Ont., this plant was erected by the Spruce Falls Power and Paper Company, and has an installed capacity of 56,250 h.p. The same company has a smaller plant on the Kapuskasing River of 2,500 h.p.



Winnipeg's municipal power plant at Slave Falls, Manitoba, illustrating the simple manner in which waters of the Winnipeg River at this point were harnessed. "Million Dollar Island" is shown in the centre of the picture, and so called by reason of the considerable reduction effected in the capital cost of this development. The island divides the stream in two parts, leaving only a short rock fill dam to divert the water around to the near side and thence to the power plant, which has a designed capacity of 96,000 h.p.

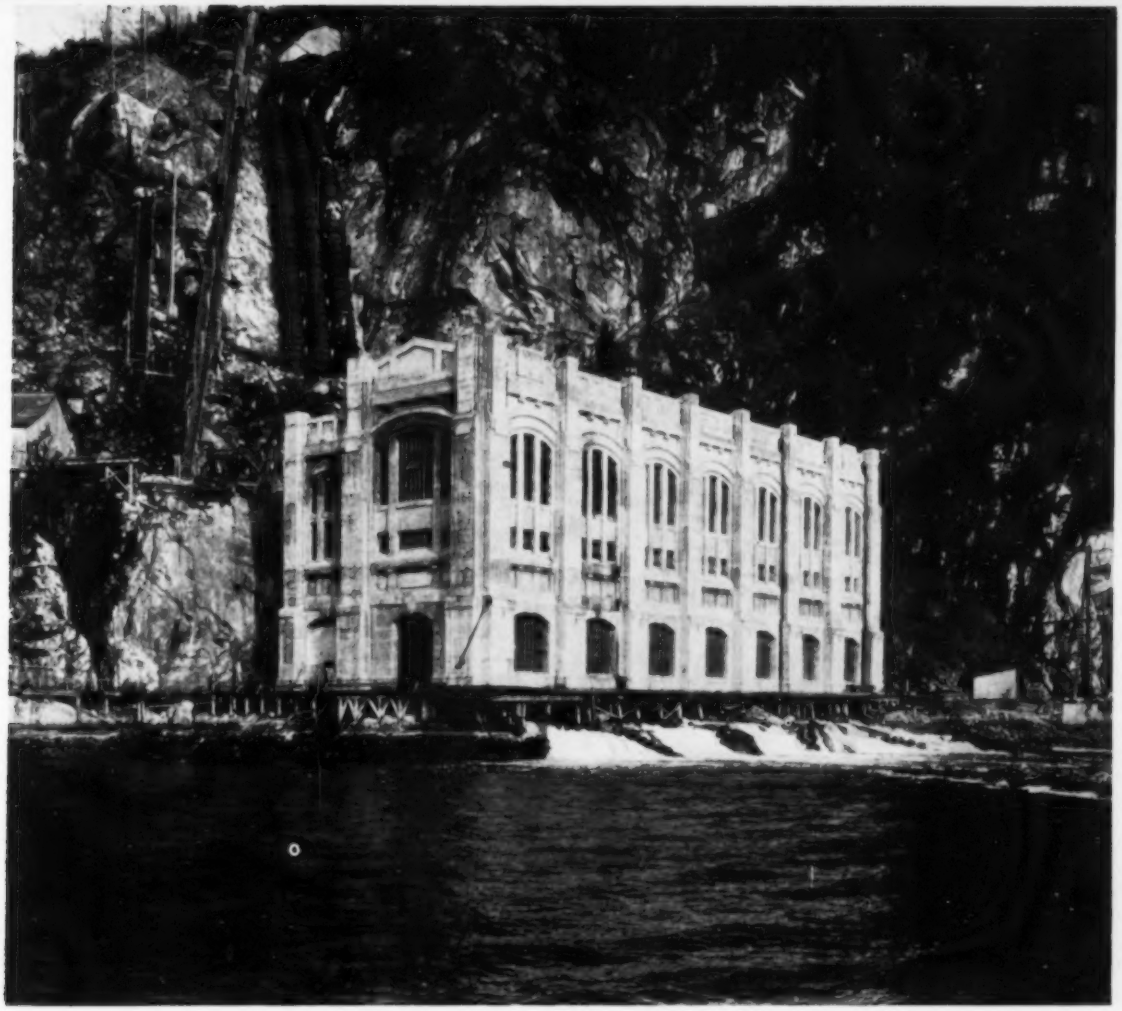
Fuel provided the necessary power for Winnipeg between 1892 and 1906, when the first hydro-electric plant was brought into operation at Pinawa. This initial development of the Winnipeg Electric Company inaugurated a programme that brought into operation the 168,000 h.p. plant at Great Falls, illustrated below, in 1926. The Seven Sisters Falls, a third development, commenced operation in 1930, and has an ultimate installation of 225,000 h.p.

Interior of the scroll case of a 47,000 h.p. turbine at the Ruskin power plant of the British Columbia Power Corporation. Through this 20-foot tube, where the man is standing, water now flows, impinging on the blades of the turbine runner at the left. Overhead is the generator on a vertical shaft, the weight on which is 65,000 pounds.



Ruskin power plant of the British Columbia Power Corporation on the Stave River, forty miles east of Vancouver, being enlarged to a capacity of 94,000 h.p. Between Stave Lake and the Fraser River, the Stave drops 260 feet, of which the Stave Falls plant utilizes 130 feet. Part of the water flowing through the Ruskin plant is used three times, having originated in Alouette Lake, passing thence through the Alouette powerhouse before reaching that at Stave Falls.

Nova Scotia Power Commission's 5,500 h.p. station at Malay Falls, on East River Sheet Harbour, which supplies electric energy for Pictou County. Four miles downstream is a plant at Ruth Falls of 6,290 h.p. This furnishes power for a pulp mill at West River Sheet Harbour. Other plants are operated by the power commission, which was established in 1919.



This 35,800 h.p. plant, situated sixteen miles from Vancouver on Burrard Inlet, is known locally as the "cathedral" by reason of its architectural beauty. It is one of five plants by which the British Columbia Power Corporation serves Vancouver. A 2½-mile tunnel was driven through the mountains from Lake Coquitlam to supply this plant with water, which drops into Pelton wheels under a head of 400 feet.

Increasing power requirements of the pulp and paper industry in Nova Scotia are being met by the further development of waters within the province. This photograph illustrates the spillway section of a 2,500 horse-power plant on the St. Croix River, now under construction by the Minas Basin Pulp and Power Company, Ltd., for its pulp mill at Hantsport.

Eight units of the Chats Falls power development on the Ottawa River, having a capacity of 230,000 h.p. Brought into operation in 1930-1931, this plant is now owned jointly by the Hydro-Electric Power Commission of Ontario and the Ottawa Valley Power Company.

Typical transmission tower, whose extended arms support cables carrying power from the Cedars Rapids plant of the Montreal Light, Heat & Power Cons. to the metropolis of Canada. The transmission lines here span the St. Lawrence River.

CAPTAIN BERNIER

LAST OF THE GREAT MASTER MARINERS

by W. Q. KETCHUM

CAPTAIN Joseph Elzéar Bernier could very well have been a character from the pen of Joseph Conrad, quickened into life. From a mere landsman's view there was no mistaking this last of the great master mariners for anything but a sailor. He had the rolling gait associated with those going down to the sea in ships, and the weather beaten face and discerning blue eyes of one who had gazed on far horizons.

Twenty-nine years ago, Bernier first turned the prow of the sturdy old Canadian Government Ship "Arctic" northward. In the intervening years half-a-million square miles comprising the Arctic islands have been explored by Canadians. This vast territory, so rich in natural resources, lying adjacent to the mainland, is to-day as much a part of the Dominion as any of the nine provinces, and is efficiently patrolled by the Royal Canadian Mounted Police. Martin Frobisher, who voyaged to the Arctic as captain and pilot of the "Gabriel" (25 tons), was the precursor of a long line of sturdy navigators who carried the British flag to the uttermost recesses of the North. His first voyage was made in 1576. He, in a sense, laid the keystone to the indisputable arch of British sovereignty.

In the wake of this pioneer came many stout hearts. Outstanding of these on the Arctic roll are undoubtedly Ross, Franklin and Perry. In the final analysis, Joseph Elzéar Bernier will be well in the forefront as one of the moderns who played a leading part in reaffirming the British and Canadian title to the islands.

Long before his death at Levis, Quebec, in December, 1934, Bernier had become almost a legendary figure north of the Arctic Circle. He was a main topic of conversation at practically every Eskimo gathering. These children of laughter, dwelling in igloo and tupek in the shadow of some ageless glacier, will mourn his passing. They heard of it first when the supply ship battled through the cruel Arctic pack with stores and an exchange of personnel for the Royal Canadian Mounted Police posts. Christmas and the arrival of the boat are the two red letter days in the Far North. This was poignantly illustrated on one occasion when a member of the Royal Canadian Mounted Police detachment at Pond's Inlet soberly asked the commander of a Canadian Arctic expedition in August what sort of a Christmas he had had.

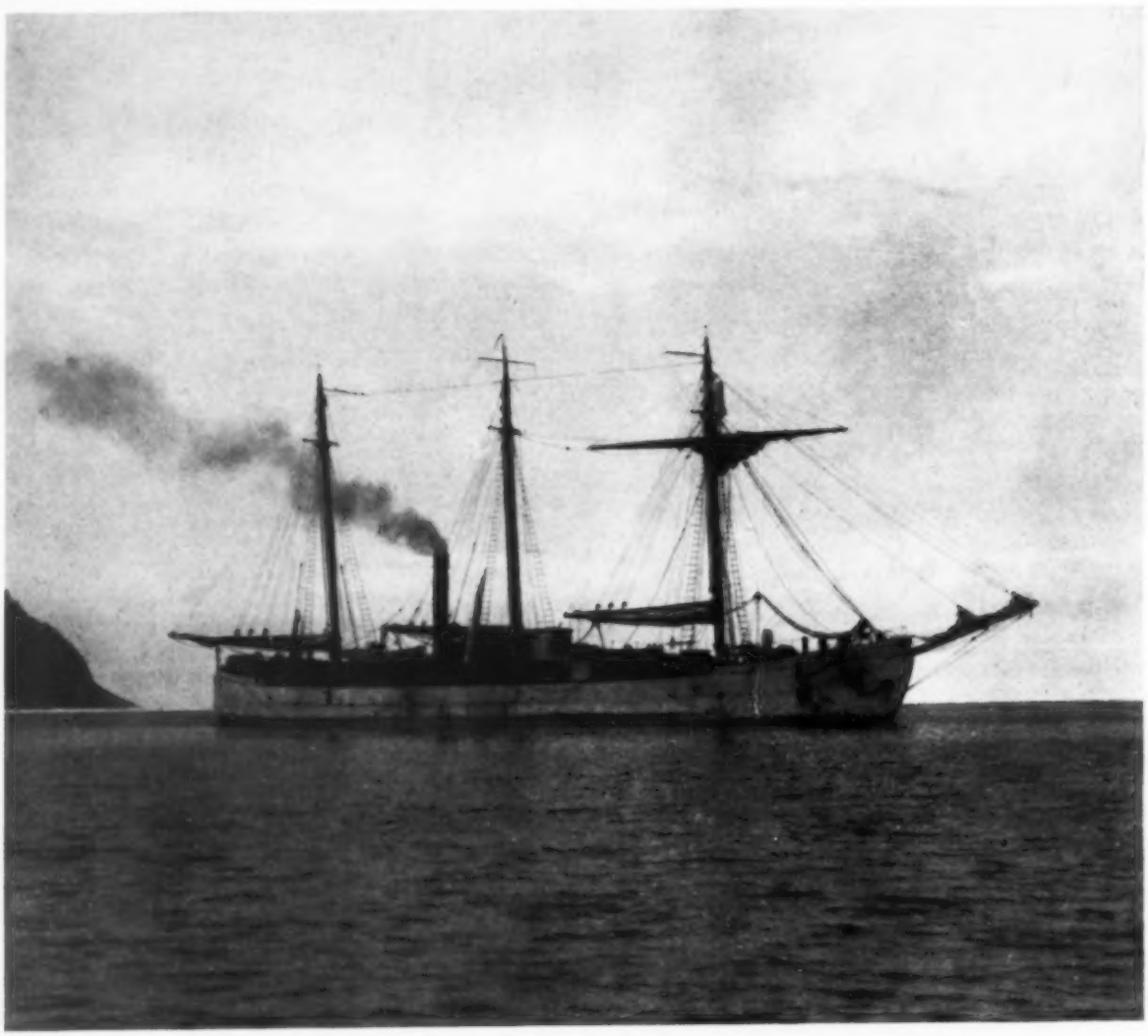
The Captain was a bearer of gifts in a literal sense, and though he in turn benefitted by what after all was an exchange, there is no record that he was a Shylock, seeking his pound of flesh. On the contrary, he was known to send cartridges annually to an Eskimo he had befriended, and to remember others with little tokens of regard.

In his heyday, the dean of Canadian Arctic explorers had command of 105 ships. It is believed that with perhaps one possible exception he never lost a ship. This lone instance of a vessel going to Davy Jones' locker was not due to faulty seamanship. It was simply a case of being torpedoed during the Great War on the high seas.

Bernier was born at l'Islet, Que., January 1, 1852, within call and sound of the sea, as the broad sweep of the St. Lawrence was at his doorstep. His father took him on his first voyage when he was three, and he continued to sail until he was seven. An nterlude of five years then followed, when he attended the Christian Brothers' school at l'Islet. Came a reunion of father and son under the white sails of ships, and at seventeen the fledgling of the sea became master of a brigantine, a remarkable record, surely, even in those days.

That was n 1867, when Canada was in the flux of Confederation, and command came in an era of wooden ships and iron men. Quebec and Saint John at that time vied with each other in turning out vessels that were the pride alike of builder and owner. Captain Bernier always spoke of the passing of those days with a tinge of regret in his voice. Each year fifty to sixty vessels glided down the slipways to enhance British mercantile prestige.

Captain Bernier crossed the Atlantic no fewer than two hundred and fifty-one



C. G. S. "Arctic"

"Arctic" in Ice—Pond's Inlet, Baffin Island, N.W.T.

times, and was familiar with most ports of call frequented by world shipping. When his contribution to his day and age is gauged by the level eyes of posterity he will be limned against a setting of icebergs, for it was in the ever-changing panorama of the Arctic setting that he really won his name and fame. In his voyages to the great sea of paleocrystic ice, he carried with him the name and deeds of all navigators who followed the will-o'-the-wisp of adventure through the North Water. His mind was a storehouse of their achievements down through the years, and few men living had read more of the printed word that preserved in simple sailor fashion the roles which they had played. Year after year he returned to Ottawa with some record which had been left in a cairn; perhaps scarcely discernible in the vast immensity of a country closed by barriers erected by nature in an age-long vigil. World famous figures, explorers and savants, planning expeditions to both the Arctic and the Antarctic, recognized this, and lost no time availing themselves of his copious knowledge and common sense counsel.

He was the essence of kindliness, and seldom, if ever, made uncharitable references to some of his contemporaries whose claims have been challenged. Shortly before he died he referred to many of the letters he had received from different celebrities. He seemed to have a soft spot in his heart even for Cook, and showed, without comment, a letter from the Doctor telling "how he found the Pole."

He rather prided himself on the fact that he had collected the first hunting license to enrich the Dominion treasury, from the internationally-known Harry Payne Whitney, of New York.

Men who served with him state that he was never happier than when a strong sea was running. This enabled him to give full play to his seamanship. Powerful of voice, he could be heard above the roar of the elements booming out words of command. And though he sat at the head of the table, he was not above lending a helping hand to an ablebodied seaman when in difficulties.

An indication of the success of his command was that the same old hands served him year after year, and swore by him as long as he followed the sea.

Something of that simple faith which served him through the storm and tempest of life must have been vouchsafed when he surrendered to a greater helmsman at Levis. He was known to read the mass on Sunday mornings north of the Arctic Circle, a choir of fine French-Canadian voices providing the musical setting to the scene.

In his life-time he was not without honour. His services were tangibly recognized by a yearly pension of $2,400 from the Department of the Interior, and he was decorated with the Imperial Service Medal by the King. An "F.R.G.S." also pleased him greatly, and when this honour was conferred on him he always signed himself J. E. Bernier, F.R.G.S.

Major-General A. W. Greeley, writing from the Cosmos Club in Washington, told the Captain, greatly to his delight, that he considered that he knew more of the archipelago north of Canada than any other man. This was a geat tribute from the Dean of Arctic explorers. And now the captain has gone to his peers and a snug berth with the brave spirits of Northward Ho!

Muskeg in September

LURE OF THE GOLDEN NORTH

by **CHARLES G. NICKELS**

(Photographs by the author)

CURRENT times in Canada are in the grip of a gold fever of high temperatures. Starting with the governments themselves, geological surveys and road-building campaigns in various mining districts have been organized to develop our hinterlands.

The "Street," whether it be St. James or Bay, is humming with brokers' offices, whose tape-worm tickers grind out the latest results of speculation from coast to coast. Speculators crowd the board-rooms, men and women occupy the ringside seats, shy clerks, stenographers and burly truck drivers clutch a few dollars nervously and inquire about a good "buy." The lobbies of the large hotels are filled with prospectors and promoters with news of "real" strikes. Even the tap-room clientele huddle over their glasses and talk furtively of "breaks" and ore bodies.

Do we ever stop to consider the outcome of this mad scramble for easy dollars? It is certain that mining is one of our leading industries, but someone has said that "industry without art is brutality."

Gold, though valuable as ore, is rarely visible without the aid of a microscope. Associated with gold, however, we have virgin forests full of game, lakes full of fish, fast rivers and unchained waterfalls. The seasons themselves dress the north country in greens, yellows, golds, scarlets, and, in winter, uniform white. It is quite natural, therefore, that the men and women, forming part of this gigantic industry, do not spend all their waking hours in the darkness of drifts and crosscuts, or bunkhouses, but often take time off "to gaze at the stars."

A prospector toils over a rough portage with heavy packs and a canoe, and deposits them on the shore of an unnamed lake. He sits down to have a smoke under some spruce trees; the wind stirs the sweeping branches and sets the lake to dancing at his feet. What could be more satisfying then, than to capture with a camera this mood of Tom Tomson's "West Wind"?

An engineer sends a surface labourer to uncover an overburden in a muskeg. It is early in September, following a light snowfall. The sun streams through banks of heavy clouds, and floods the surface of the muskeg with brilliant glow. He rests on his shovel a moment to gaze in admiration at the wet snow, clustered like cotton blooms on the Labrador Tea plants, or the scrub spruce, squatting like Christmas trees on the billowy surface.

A timber cruiser is sent out by the mine office to locate a stand of trees, for fuel. He is tramping along the bed of a frozen stream, and stops to tighten his snowshoe thong. A frozen waterfall meets the eye, and rising vapour from fissures on its face collects in rime on the overhanging trees; one of which is so laden that its top has been bent over and frozen in the ice. He is not an expressive type of man, but he studies it with the appreciative eyes of one attuned to woodland beauty.

The noon whistle blows at the mine on the hill, and hurrying groups of underground workers clump down the broken muck road toward the bunkhouses. Above, drifts a huge white cloud. A Swedish drill-runner turns to his partner and says, "Nice wedder we having"; the other man is watching the cloud and smiles, "Ja."

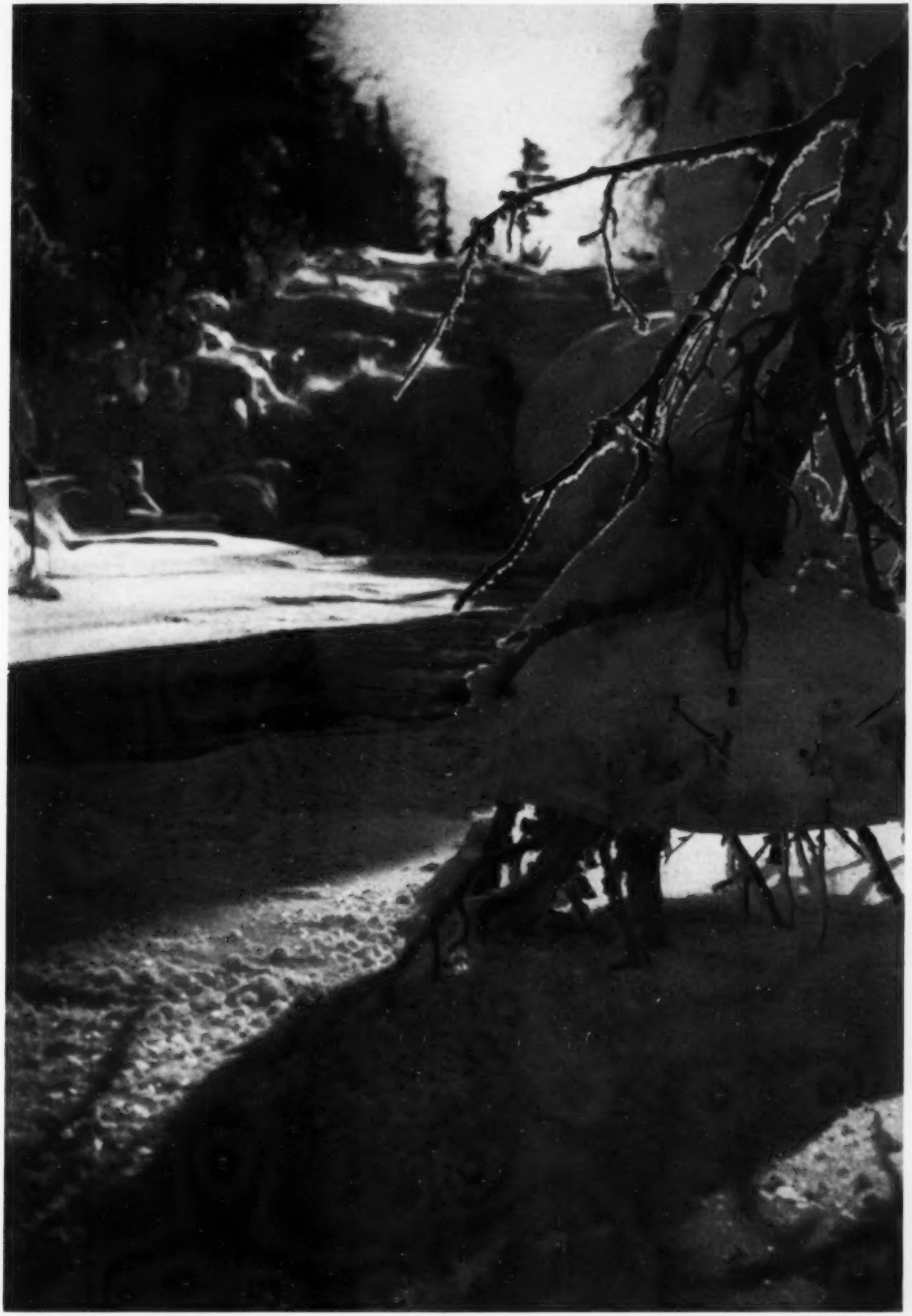
Flying into a bush gold camp in early spring, a pilot banks his plane over the plant buildings. A rushing glimpse of man-made disarray flashes past—a gaunt timber head-frame, sprawling ore dumps, piles of lumber and mining timbers. Yet, a few hundred yards beyond, where the plane alights, nature is again seen adorned in picturesque woodland garb.

There are prospectors who, over a period of many years, have followed the golden gleam from Yukon to the Labrador. During this time they have amassed hundreds of photographs of places in which they have stayed. They were never too pressed in their hurried and nomadic calling to fail to record scenes which nature had to offer. To-day these collections are invaluable.

It is from northern people, associated both directly and indirectly with the mining of our metals, that these pictures in unlimited quantities can be secured. They are the ones who are proving to all of us that theirs is not an industry without art, but one of intellectual advancement!

Road to the bunkhouses

West wind



Frozen waterfall

THE FUJI LAKES

by LORETTA L. SHAW

FOR years the five lakes around the base of Mt. Fuji have been famous for their scenic beauty. But up till ten years ago a trip around the lakes was rather a venture of faith. In order to allow for bad weather it needed a week of time and a great deal of walking or horseback riding, and was also rather expensive. So, though I have been in Japan thirty years, last year was the first time I attempted it.

And now how easy it is! The train on which we left Tokyo was most comfortable with plenty of room and an electric engine. This city, now the third largest in the world, stretches out far in the great Musashino plain. This plain is crossed by three great rivers emptying into Tokyo bay. It is very fertile, and cuttings for roads or tunnels reveal a loose loam soil that extends down fifty feet or more without a stone or even a layer of gravel. The farms, consisting mainly of kitchen gardens raising vegetables and fruit for Tokyo, stretch out for miles in all directions. In the Osaka plain the soil is so heavy that oxen are used for all ploughing, but around Tokyo horses are employed as the soil is much lighter.

Over the beautifully cultivated fields, tended by each peasant family with such loving care, fall the rays of the setting sun; and there in all its glory stands out Mt. Fuji, the peerless mountain. No wonder it has always been the symbol of perfect beauty for the Japanese. For truly, Fuji seems like a goddess, rising serene, majestic, above the earth, and looking benignly down upon the land with its countless struggling, striving men and women.

Between us and Fuji are the lower ranges, and our train darts now through tunnel after tunnel. As we emerge each time, we fly past a tumbling river, fertile rice fields, brown thatched cottages, forest covered hills, here and there a small town, and always pylons and power stations carrying electric power down to Tokyo.

Just at six o'clock we reach the first lake — Kawaguchi. There is a small town here for the lake is fairly large and there are many hotels.

The man in the bus calls out the name of our hotel, and at once two men step up dressed in the simple cotton livery of Japanese inns with the name of the hotel on the back of their kimonos in artistic Japanese characters. They at once take our small bags and we walk along the edge of the lake to the hotel. It is already dusk, and the lights of the inns along the road and across the water look exactly as they are depicted in Hiroshige's wood block pictures. The inns are two and three stories high and, as the whole front is of glass or paper, the electric lights shine through and cast lovely reflections on the water. Every village and most farmhouses in Japan have electric light and an adequate water supply.

Arriving at the inn, half-a-dozen maids greet us with the usual "Welcome! please come in," so off go our shoes and we step up on the polished floor. We are conducted upstairs and along wide corridors, past many wide open, matted rooms to the end room in one wing. Here are two large rooms opening into each other with the usual sliding doors of paper and glass.

Leaving our hotel slippers at the door, we enter and see the lake from the little balcony in front, with Mt. Fuji rising straight up behind us. The stars are coming out, the sky crystal clear in deep blue. On the top of Fuji white snow glistens, and the outline of the clearly defined cone is marvellously beautiful.

But we are soon recalled to mundane things, for our host appears to enquire how long we will stay and what price we wish to pay. We settle for supper, breakfast and room for two dollars each. Our host has spent ten years in America as a cook, and he insists that our breakfast shall be à l'Américaine. We yield, but insist on a Japanese supper, much to his regret.

Then the maid comes to escort us to the bath, for no self-respecting traveller is expected to eat until after the bath. It is

LEFT:—Fujiyama, beautiful quiescent volcano of 12,395 feet, west of Yokohama, and the highest mountain in Japan. Its southern slope descends to the sea, but on the other three sides the plain from which it rises is surrounded by mountains, among which picturesque lakes were formed by the damming of rivers with ashes from Fuji's crater. These have an altitude of 3,160 feet.

almost a religious rite. We put on the Japanese kimono of the inn; and as each has its own variety, you know in which hotel anyone you may meet is staying.

The bath is large enough to admit thirty bathers at a time and the water is very hot, but can be cooled as much as one likes as it quickly boils up again. Family parties usually go in together, but the foreigner is known to be peculiar and he is allowed to go in by himself. In most places you have to provide your own towel, but in this hotel fresh towels are furnished.

As soon as we were in our rooms again two maids came with the supper, which was indeed a feast. Raw fish and fried eels were the specialty of the hotel, as lake Kawaguchi furnishes seven kinds of very good fish. Everything was well cooked and beautifully served in fine lacquer bowls, and when we had partaken well of the repast in came a whole set of foreign dishes! Needless to say we could not do justice to them, for we had already had a complete meal from soup to fruit.

When the maid cleared away the meal, a clerk came in to write down our names, ages, country, and address, to hand to the police. Meanwhile, the maids spread our beds upon the floor—three thick, heavily padded silk quilts under us and two over us.

I woke before five and stayed awake hoping to see the dawn on Mt. Fuji. It was very cold, and after opening our paper sliding windows so that we could look out, slipped back inside the quilts. Soon I aroused my companion for the dawn was coming. Rose pink flushed the white, snow-crowned Fuji, clearer and clearer against the dark sky. Breathless we watched in the vast silence of the dawn. Then suddenly, up came the sun and the whole mountain glowed with light, and in a few moments all the pink was gone. A glorious day had dawned and Fuji, with not a cloud from base to summit, stood out against the autumn sky, clear as crystal, with her pure white crown, her brown slopes and green forests.

As we crossed lake Kawaguchi the reflection of Fuji in the calm lake was perfect. We seemed to be floating in a dream world and scarcely could tell which was the real Fuji, the one in the lake or the one in the sky. Every hill and every tree stood out distinctly, and the few clouds now and then cast shadows. The boatman was delighted and told us we might come a hundred times and not get such a perfect reflection. At the hotel they told us it was the first day in weeks for Fuji to be completely visible. On the opposite shores many trees had changed colour, and the reds and browns of maple and lacquer and blazing bushes were also reflected in the clear water. The boatman told us the names of the princes and others who owned the beautiful villas around the lake.

At the far side we walked a little way to get the bus. Brown, thatched farm houses skirted the road, standing in the midst of the cultivated fields, and from the upper storey of each hung rows upon rows of drying corn still on the husks. It was a brillant orange in colour and gave such a warm touch to the autumn scene. As no rice can be raised there, Indian corn is a great adjunct to the winter food supply. It is roasted and eaten, and also ground into meal. That and mulberry bushes for silk worms were everywhere. A special native silk is woven here on hand looms, and is used to line the kimono, as it has a slippery surface.

Leaving the bus we climbed a hill called Mapleview, from the top of which one has a magnificent panorama. The second lake lay below us like a jewel sparkling in the sunshine. Steep pointed hills rose all round it, heavily wooded. At the outlet dales and plains spread out. Behind towered Fuji in her splendour, and upon her cloak, as it were like a wonderful brocade, rose forest after forest, the nearest one with gorgeous reds and yellows in amongst the greens—a scene to store in the memory and to keep amongst one's choicest treasures.

Back to the bus and on through the great forest seen from the look-out; a very lovely drive. Then in to the third lake, Shoji, considered one of the loveliest. Behind it rise the same pointed hills, clad to the water's edge with thick green forest, but up these wind paths and from the top magnificent views are obtained.

The fourth lake is very lovely in shape as it winds about, but decidedly gloomy, as the hills press too close together and the lake soon loses the afternoon sun. Somehow one thought of ghosts there, with no friendly houses at the edge of

LEFT:—(Upper) Buddhist altar arranged for funeral or memorial service. (Centre) Relatives in Shinto mourning garments. (Lower) Arrangement of funeral wreaths.

the lake, no open valleys for cultivation. There are only a few old tea houses at the end of the lake on its rocky, inhospitable shores, as there is no good farm land near at hand. However, good bowls of hot chicken and rice, well flavoured with seaweed, were obtained here, and fortified by these the travellers returned to the motor bus.

These buses run back over the same route until the first lake is reached—lake Kawaguchi, from which we started. The return trip gives one an opportunity to study more closely the beauty of the wide moors that skirt the base of Fuji and to admire the magnificent mass of the peerless mountain. The unique quality of Fuji is that it rises almost from sea level and stands alone, and the whole height and beauty of outline can be seen from every side.

Leaving lake Kawaguchi and its quaint village houses, surrounded with their golden Indian corn and green mulberry, we quickly entered forests very similar to those of Canada, and in an hour we were beside the last and largest lake in the chain—lake Yamanaka. To Canadian eyes this is the most beautiful of all, for one side of the lake is quite open, with park like land. The trees and the mountains on the farther side and the water of the lake are therefore sunny all day long. It is the spaciousness, the openness, and the sunniness that delight a Canadian eye. Then, also, the parks and trees might be anywhere in Canada. Here we are up about 4000 feet with the air and the flowers like those of our homeland.

The reflection of Fuji in the open, sunny waters of this lake was perfect, and the beauty such as to take one's breath away. This lake, however, has been difficult to reach and good drinking water was hard to obtain. It is only in recent years that summer cottages and camps have appeared. Now that the buses run there several times a day and good springs have been found it will rapidly become popular. As winter sports grow in favour, ski-ing grounds and lake skating are bringing many up to the lakes in winter as well as in summer.

From lake Yamanaka a wide new road winds down the steep flank of the mountain. The views from this are marvellous and make one forget the danger of the descent.

In about an hour we are low enough down to find again cultivated fields and thatched cottages past which the little brooks go tinkling and rushing, carrying the water to the paddy fields. We are now about 2000 feet above sea level, and the farm lands spread out wider and wider as we go down to Gotemba, with its little town near the station and its summer resort higher up in its hills.

Here we saw the sun set behind Fuji in golden light.

RIGHT: — Fuji and the familiar pine.

BELOW: — Farmhouses, villas and cottages assembled on Lake Kawaguchi, at the foot of Fujiyama.

Farmhouses, with adjoining ricks of rice and barley straw, adorn the slopes of Mt. Fuji, which are cultivated to a height of 1,500 feet. Thence extends for another 2,500 feet a grassy moorland, from the upper edge of which climbs a forest to some 8,000 feet. Ashes and scoriae clothe the remaining 4,395 feet.

Lake Motosu, between Jujiyama and one of the surrounding mountains, a picturesque sheet of water.

Clouds cast a coronet around the summit of Fuji, the peerless mountain revered by the Japanese. In the foreground are trees burned during an eruption.

Six trails lead to the summit of Mt. Fuji, up whose sacred slopes swarm thousands of pilgrims, for some of whom pack horses are available.

Thatch-roofed cottage, a form of construction utilized by both peer and peasant in Japan.

EDITOR'S NOTE BOOK

J. T. Johnston, B.A.Sc., C.E. who in this issue contributes "Canada's Water Power Wealth," was born in Kincardine, Ontario. As Director of Water Power in the former Department of the Interior and as Controller of the Dominion Water and Power Bureau in the newly organized Department of Mines and Resources, he needs no introduction to the hydro-power industry of Canada.

Mr. Johnston is Member of the Canadian National Committee of the World Power Conference; Vice-President of the International Association of Scientific Hydrology; and member of numerous other Boards and Committees having to do with the Dominion's water-power resources. He is Member for Canada on a number of international waterway Control Boards and is Technical Adviser to the Department of External Affairs on international waterway matters.

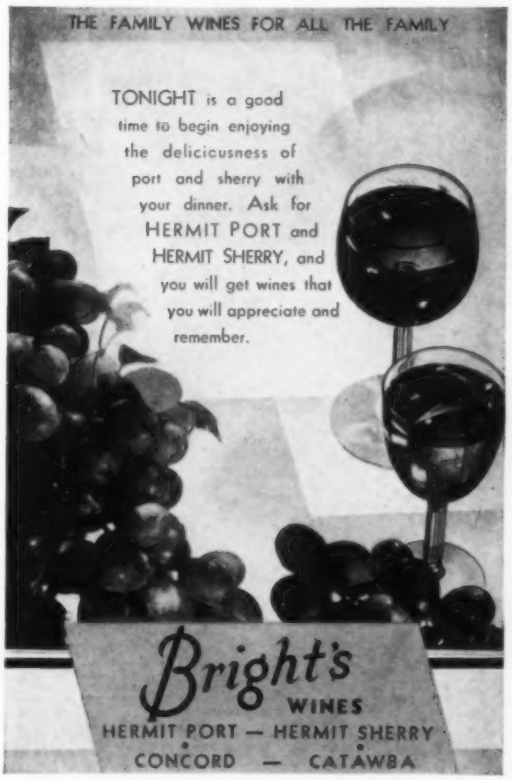
Mr. Johnston is a graduate of the University of Toronto, receiving his degree in 1910, and the professional degree of C. E. in 1916. In the course of his activities he has prepared and published, as Water Resources Papers, several works of note having to do with power, storage, and related studies.

W. Q. Ketchum, who contributes the article entitled "Last of the Great Master Mariners" in this issue, knew Captain Elzéar Bernier intimately over a long period, and accompanied the 1926 and 1927 Canadian Arctic expeditions as historian.

Chas. G. Nickels, whose article on the "Lure of the Golden North" appears in this issue, lived in Peterborough and attended the Collegiate Institute there. Since 1924, he worked as a cost accountant with industrial firms in the United States and Canada, and three years ago proceeded to the Woman lake area of the Patricia district, where he was engaged in mine office work; with sketching, writing and photography as hobbies. For the past year Mr. Nickels has been doing freelance photography and writing on various mining fields and life in the North.

Loretta L. Shaw, whose contribution "The Fuji Lakes" is published in this issue, was born in Saint John, New Brunswick, of Loyalist Stock and educated at Saint John High School and University of New Brunswick; honours in English Literature and Modern Languages, Douglas Gold Medal, etc. For a time she taught in the Boston High School and since 1904 has been an educational missionary of Woman's Auxiliary of Church of England in Canada.

Miss Shaw has given many lectures and written numerous articles on Japan, also wrote "Japan in Transition" mainly as a study book for young people. She is intensely interested in every part of Japan's life and progress. Having been stationed in Asaka and Tokyo, Japan's largest cities, she has had a unique opportunity to observe every phase of life and progress. She is at present in charge of Christian literature for women and children.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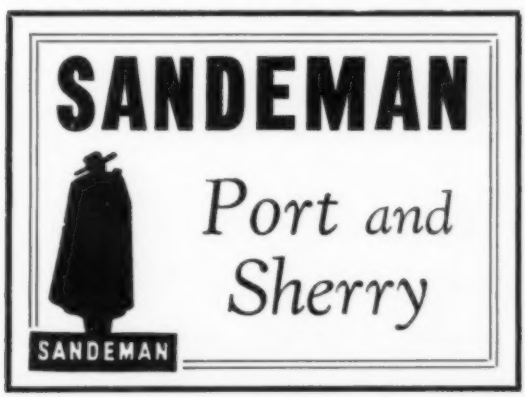

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Commencing with the October issue, the Canadian Geographical Journal will be published the first week of the current month.

The Christmas number will be published December 1; orders for Gift copies should be placed not later than November 15.

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